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(54) **EDITING OPERATIONS FACILITATED BY METADATA**

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Related U.S. Application Data

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(51) **Int. Cl.**

G06F 17/24 (2006.01)
G11B 27/034 (2006.01)
G11B 27/34 (2006.01)
G11B 27/32 (2006.01)

(52) **U.S. Cl.**

CPC ***G11B 27/034*** (2013.01); ***G11B 27/322*** (2013.01); ***G11B 27/34*** (2013.01)

(58) **Field of Classification Search**

CPC G06F 17/30017; G06F 17/24; G06F 17/30038; G06F 17/30044; G06F 17/30056; G06F 17/3082; G11B 27/034; G11B 27/34; G11B 37/322

USPC 715/203–203, 230, 231, 234, 277, 716, 715/717, 730, 731

See application file for complete search history.

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(Continued)

Primary Examiner — Wilson Tsui

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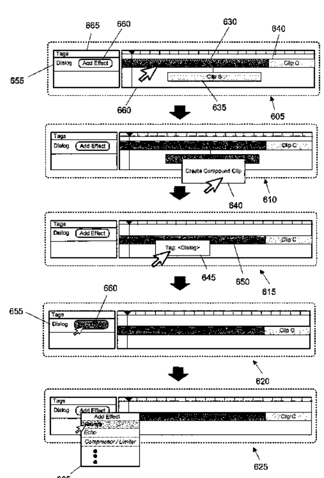
(57) **ABSTRACT**

Some embodiments provide a media editing application that uses metadata or metadata tags associated with media content to facilitate editing operations. In some embodiments, the editing operations are performed on the media content at various different stages of the editing process in order to create a composite presentation. In creating the composite presentation, one or more effects are associated with a metadata tag. Once the effects are associated, the media editing application applies the effects to different pieces of media content tagged with the metadata tag in order to create the composite presentation.

20 Claims, 25 Drawing Sheets



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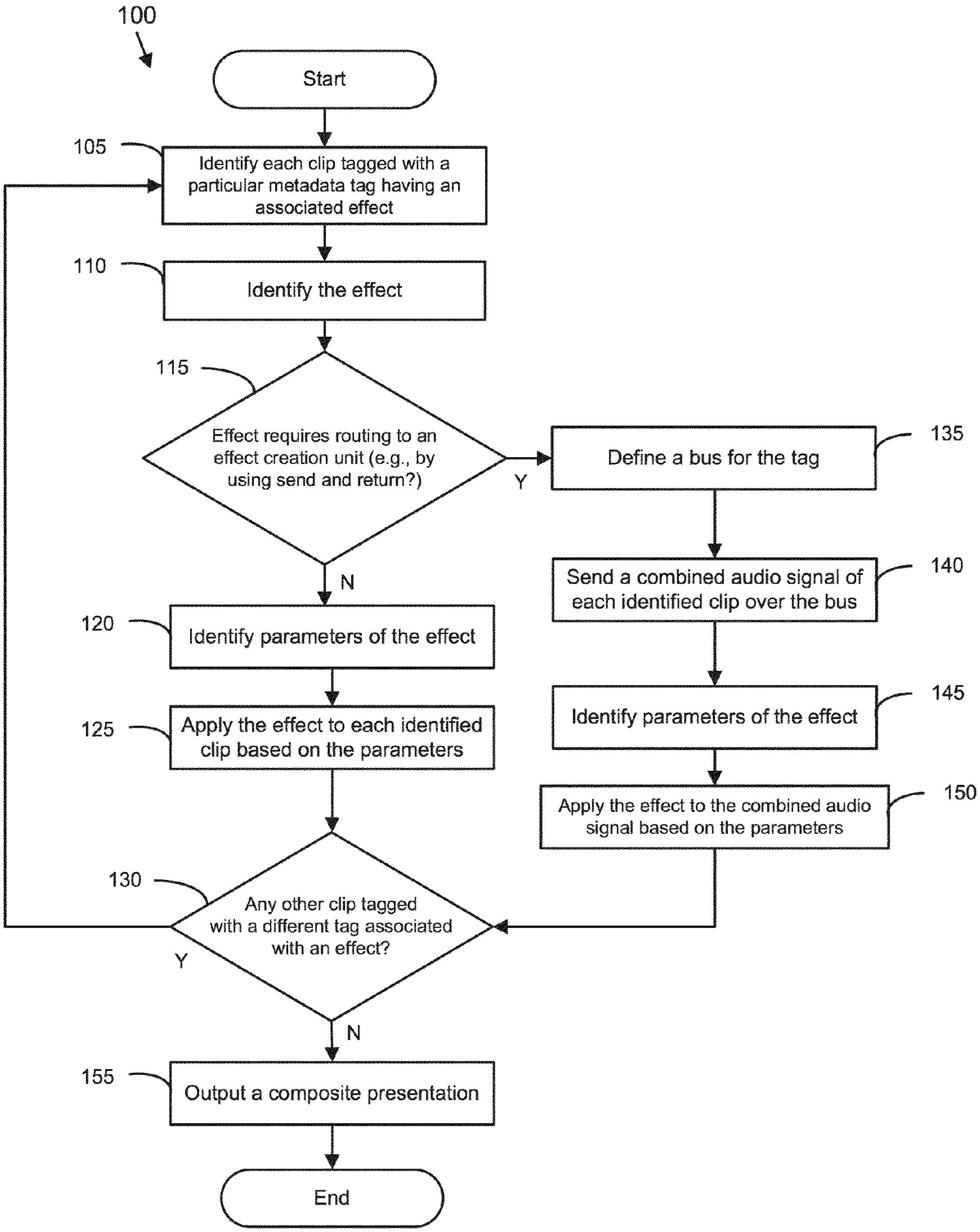

100
Start
105
Identify each clip tagged with a particular metadata tag having an associated effect
110
Identify the effect
115
Effect requires routing to an effect creation unit (e.g., by using send and return?)
Y
135
Define a bus for the tag
140
Send a combined audio signal of each identified clip over the bus
145
Identify parameters of the effect
150
Apply the effect to the combined audio signal based on the parameters
N
120
Identify parameters of the effect
125
Apply the effect to each identified clip based on the parameters
130
Any other clip tagged with a different tag associated with an effect?
Y
N
155
Output a composite presentation
End

Figure 1

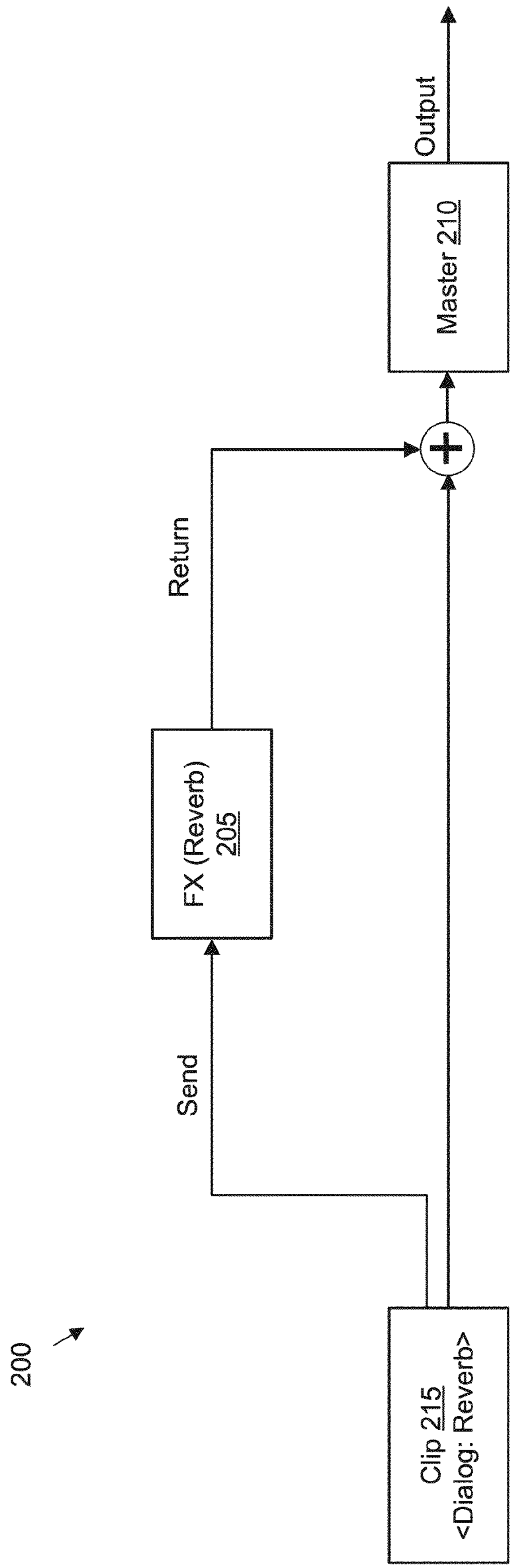

200
Clip 215
<Dialog: Reverb>
Send
FX (Reverb)
205
Return
Master 210
Output

Figure 2

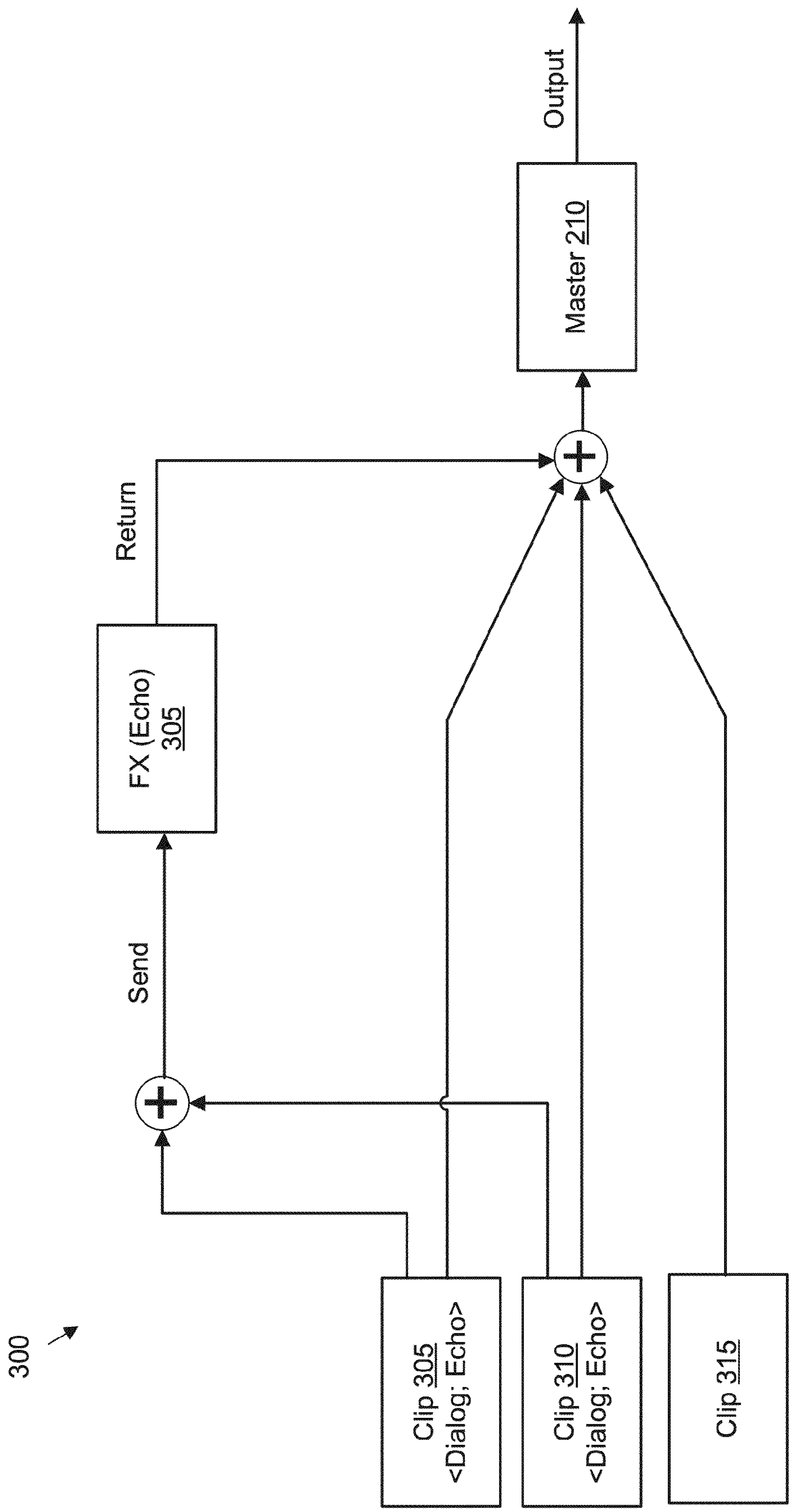

300
Output
Master 210
Return
FX (Echo)
305
Send
Clip 305
<Dialog; Echo>
Clip 310
<Dialog; Echo>
Clip 315

Figure 3

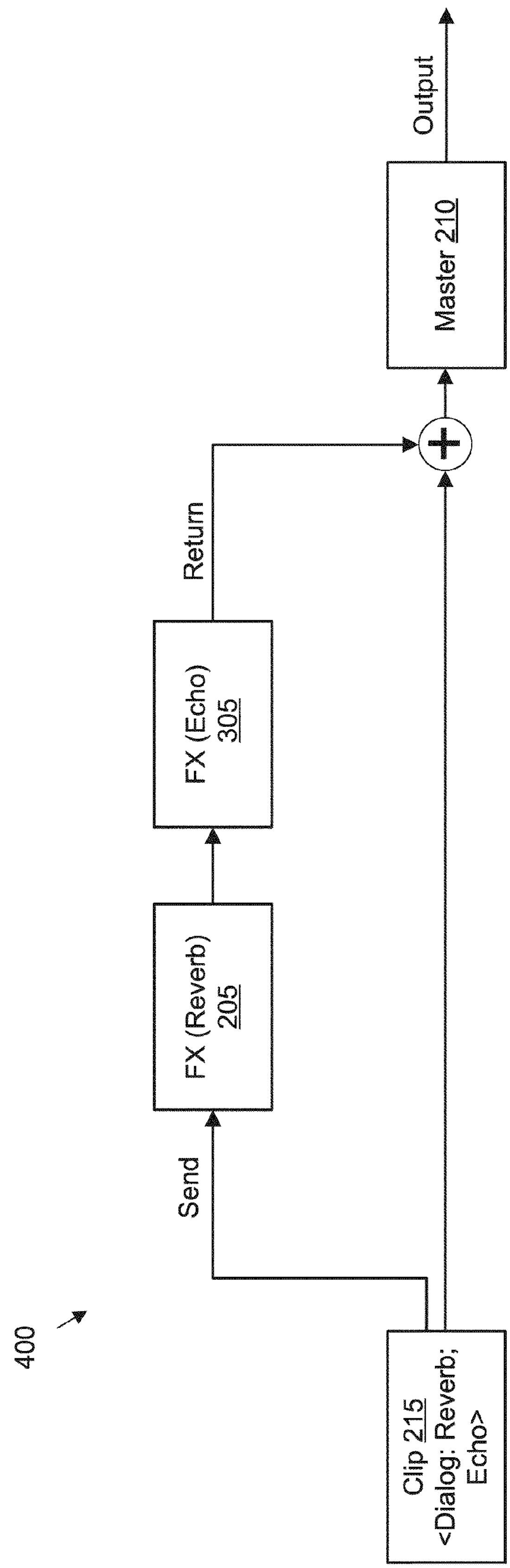

400
Clip 215
<Dialog: Reverb; Echo>
Send
FX (Reverb)
205
FX (Echo)
305
Return
Master 210
Output

Figure 4

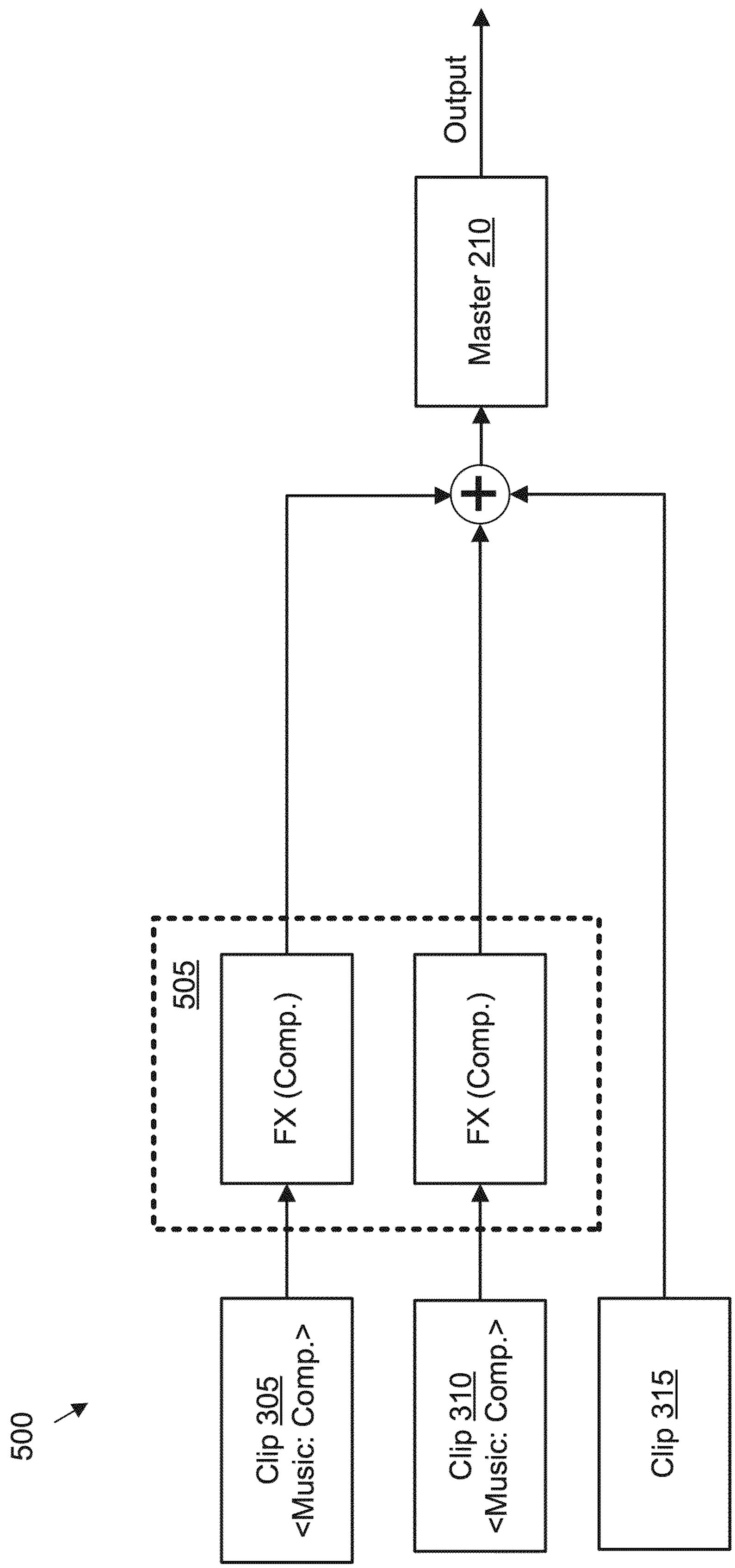

500
Clip 305
<Music: Comp.>
Clip 310
<Music: Comp.>
Clip 315
505
FX (Comp.)
FX (Comp.)
Master 210
Output

Figure 5

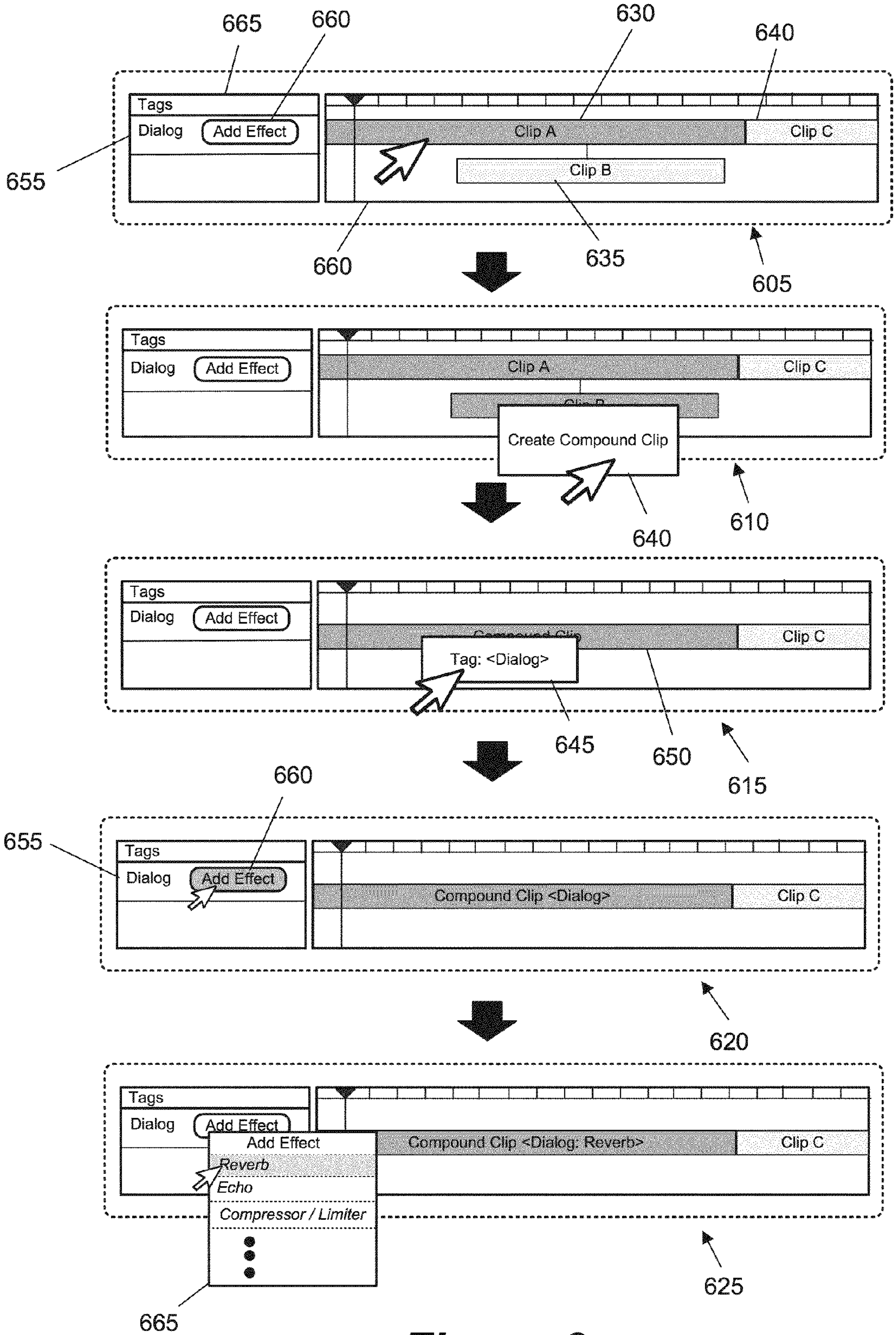
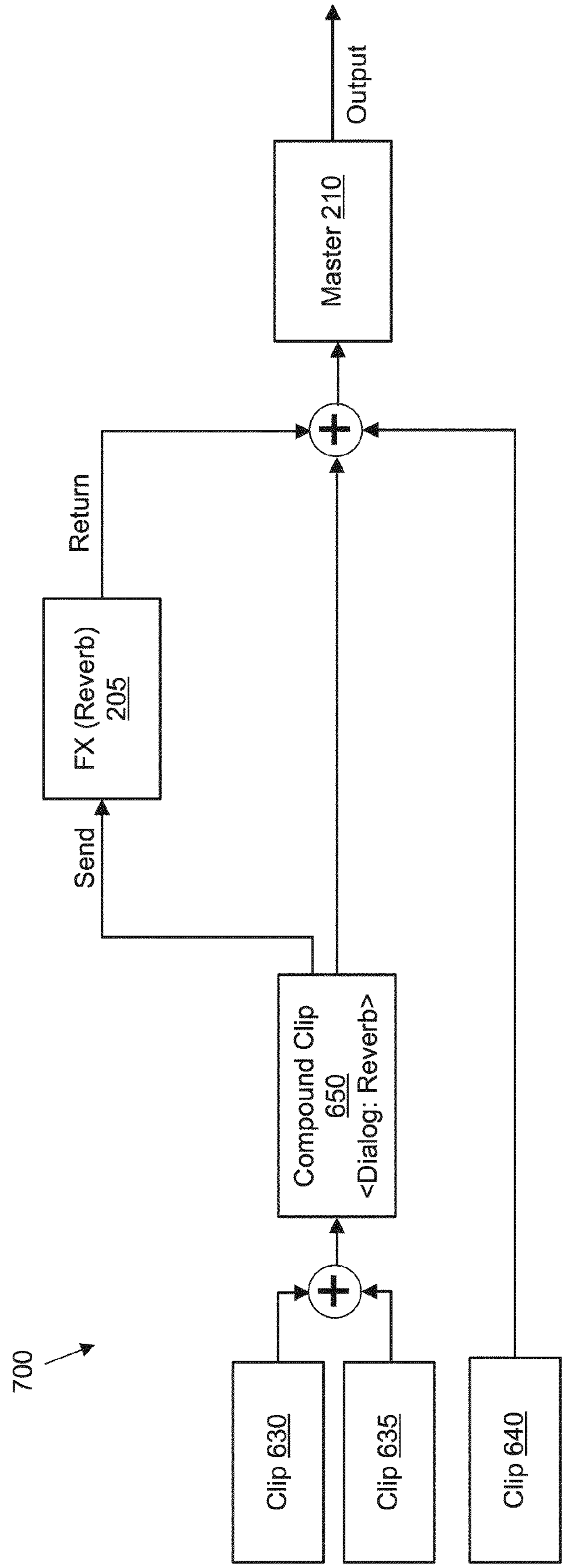

665
660
630
640
655
Tags
Dialog
Add Effect
Clip A
Clip C
Clip B
660
635
605
Create Compound Clip
640
610
Tag: <Dialog>
645
650
615
Compound Clip <Dialog>
620
Compound Clip <Dialog: Reverb>
Reverb
Echo
Compressor / Limiter
625
665

Figure 6



Output
Master 210
Return
FX (Reverb)
205
Send
Compound Clip
650
<Dialog: Reverb>
700
Clip 630
Clip 635
Clip 640

Figure 7

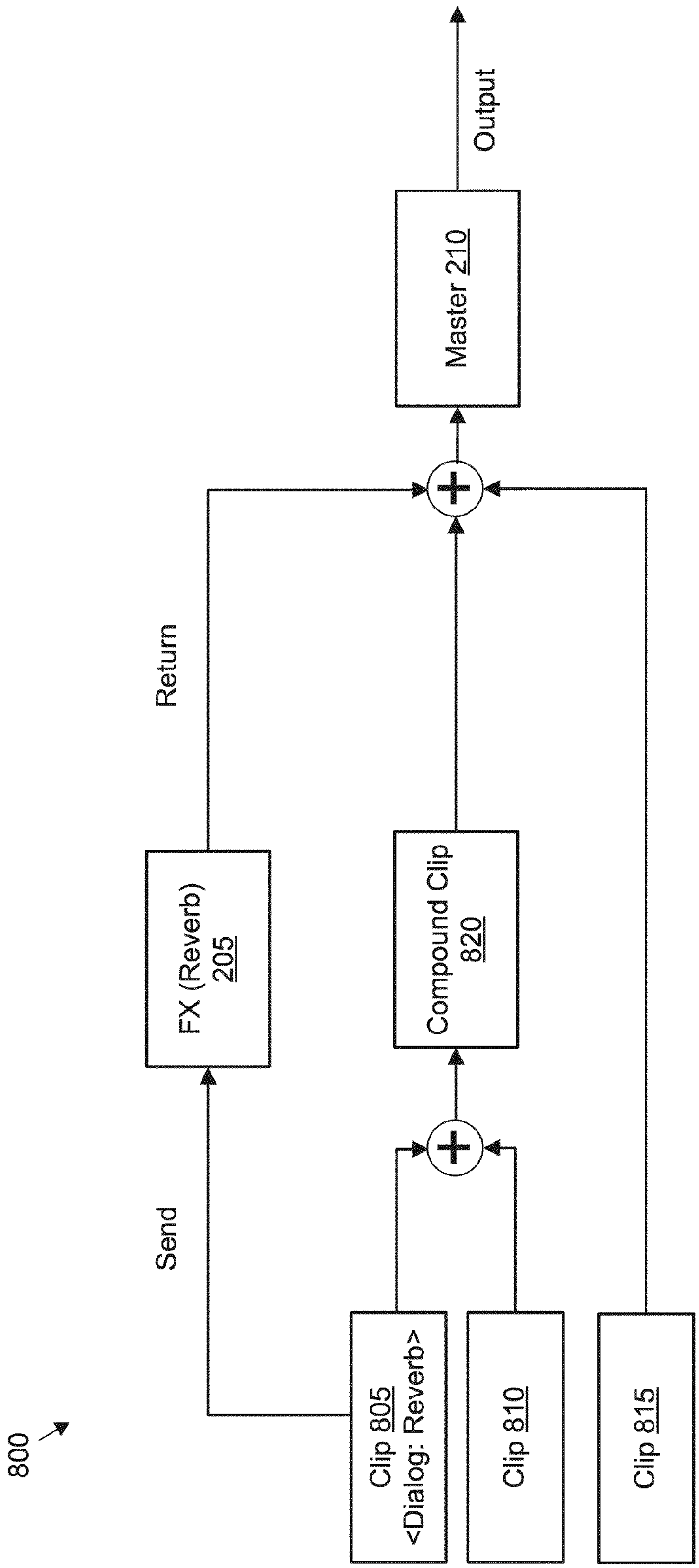

800
Output
Master 210
Return
Send
FX (Reverb)
205
Compound Clip
820
Clip 805
<Dialog: Reverb>
Clip 810
Clip 815

Figure 8

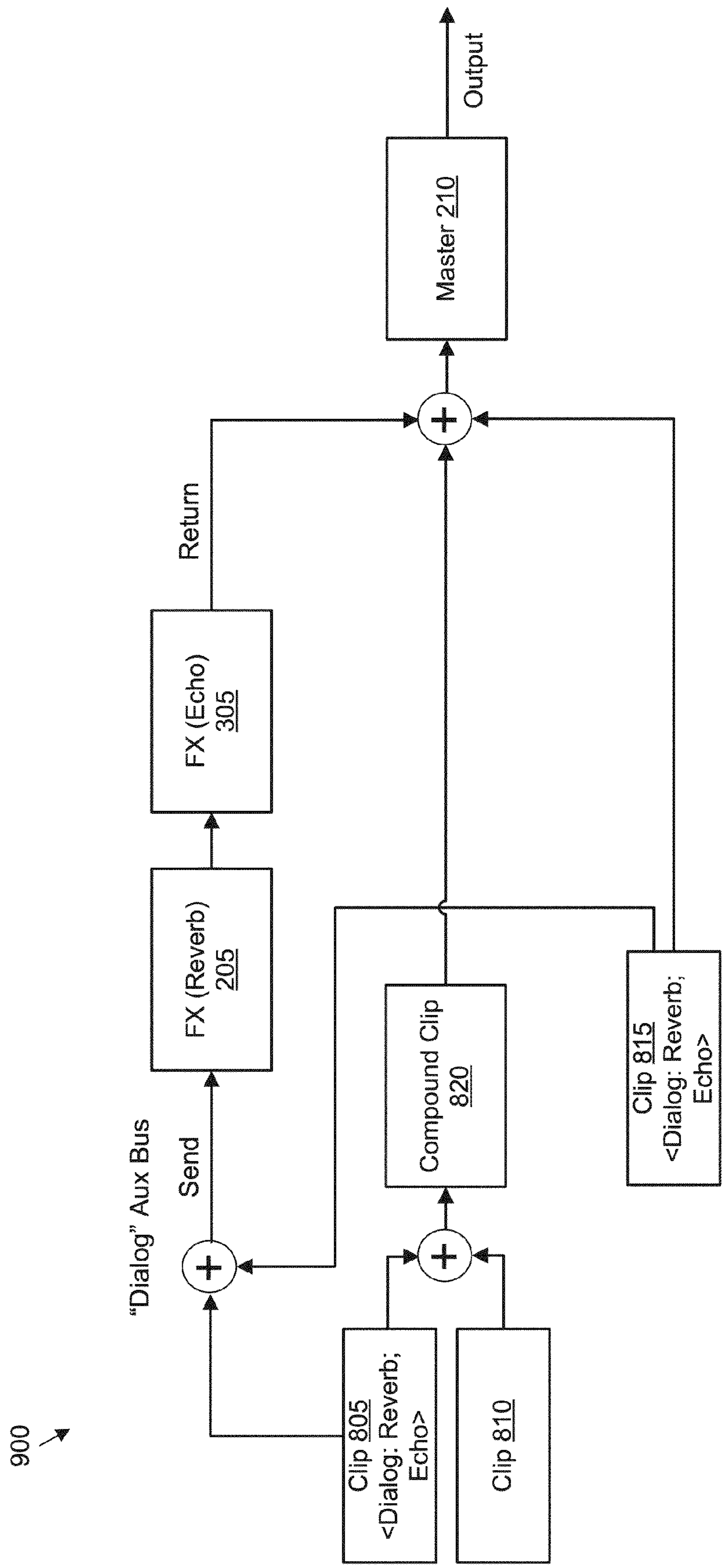

900
"Dialog" Aux Bus
Send
FX (Reverb) 205
FX (Echo) 305
Return
Master 210
Output
Clip 805 <Dialog: Reverb; Echo>
Clip 810
Compound Clip 820
Clip 815 <Dialog: Reverb; Echo>

Figure 9

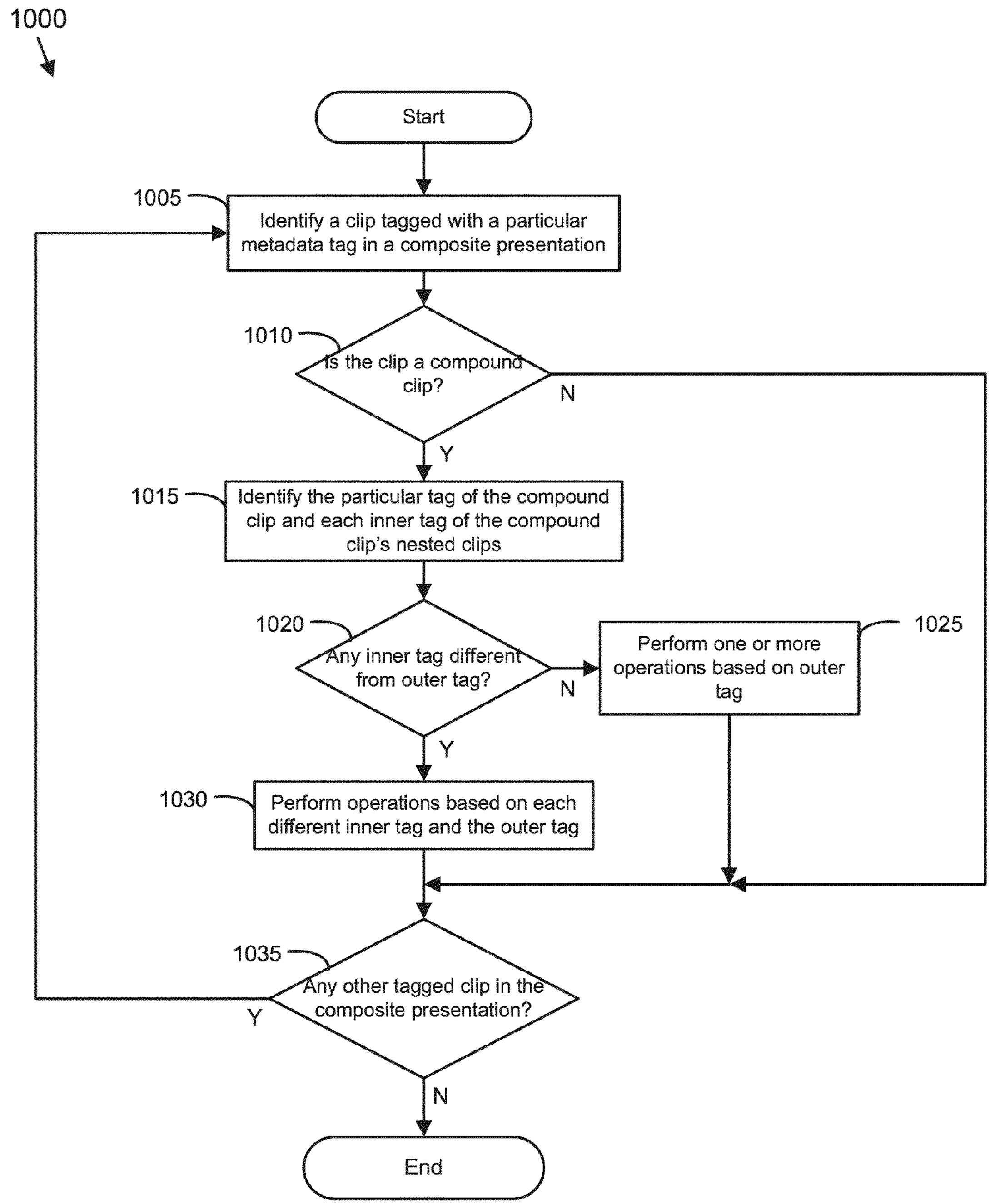
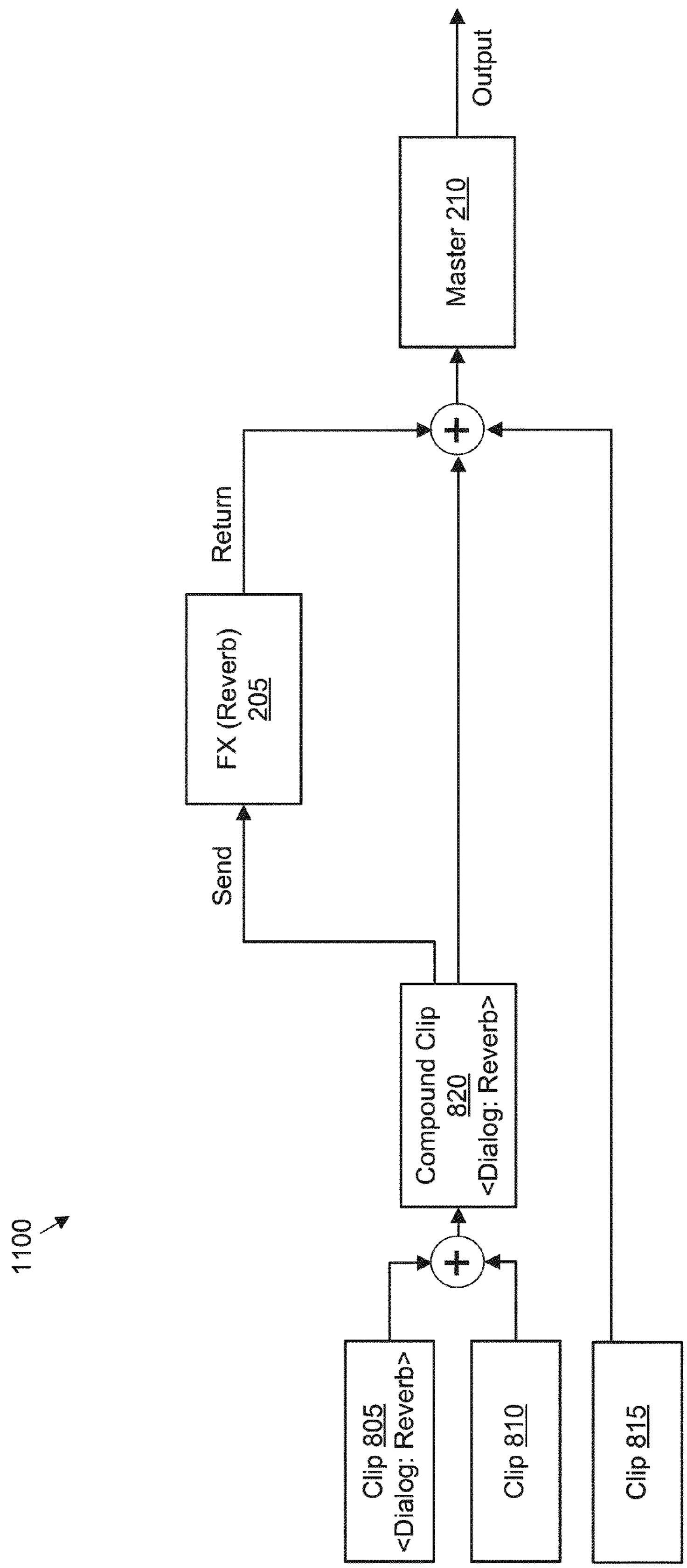

1000
Start
1005
Identify a clip tagged with a particular metadata tag in a composite presentation
1010
Is the clip a compound clip?
N
Y
1015
Identify the particular tag of the compound clip and each inner tag of the compound clip's nested clips
1020
Any inner tag different from outer tag?
N
Y
Perform one or more operations based on outer tag
1025
1030
Perform operations based on each different inner tag and the outer tag
1035
Any other tagged clip in the composite presentation?
Y
N
End

Figure 10



1100
Clip 805
<Dialog: Reverb>
Clip 810
Clip 815
Compound Clip
820
<Dialog: Reverb>
Send
FX (Reverb)
205
Return
Master 210
Output

Figure 11

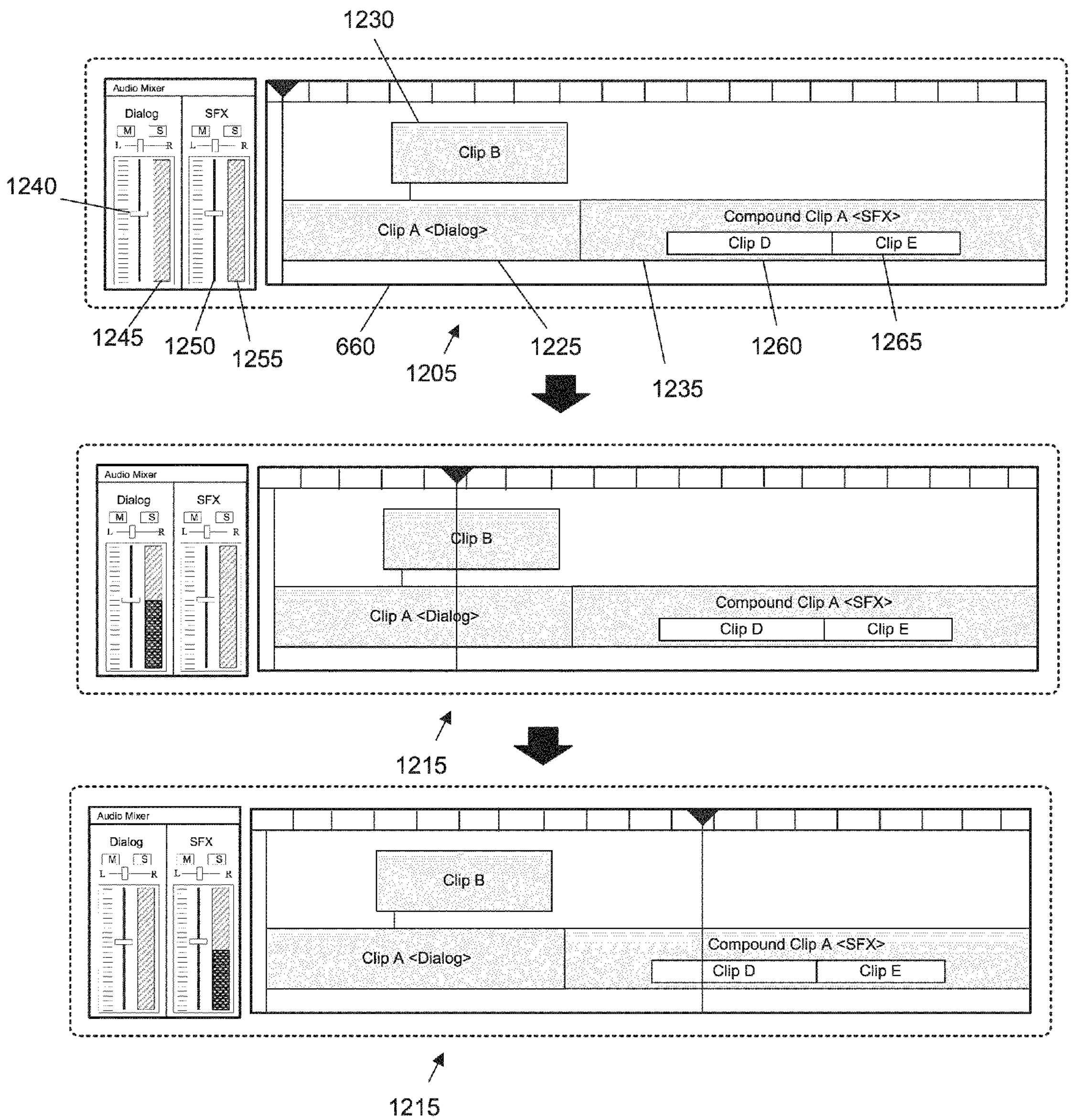

1230
1240
Audio Mixer
Dialog
SFX
M
S
L
R
Clip B
Clip A <Dialog>
Compound Clip A <SFX>
Clip D
Clip E
1245
1250
1255
660
1205
1225
1235
1260
1265
1215
1215

Figure 12

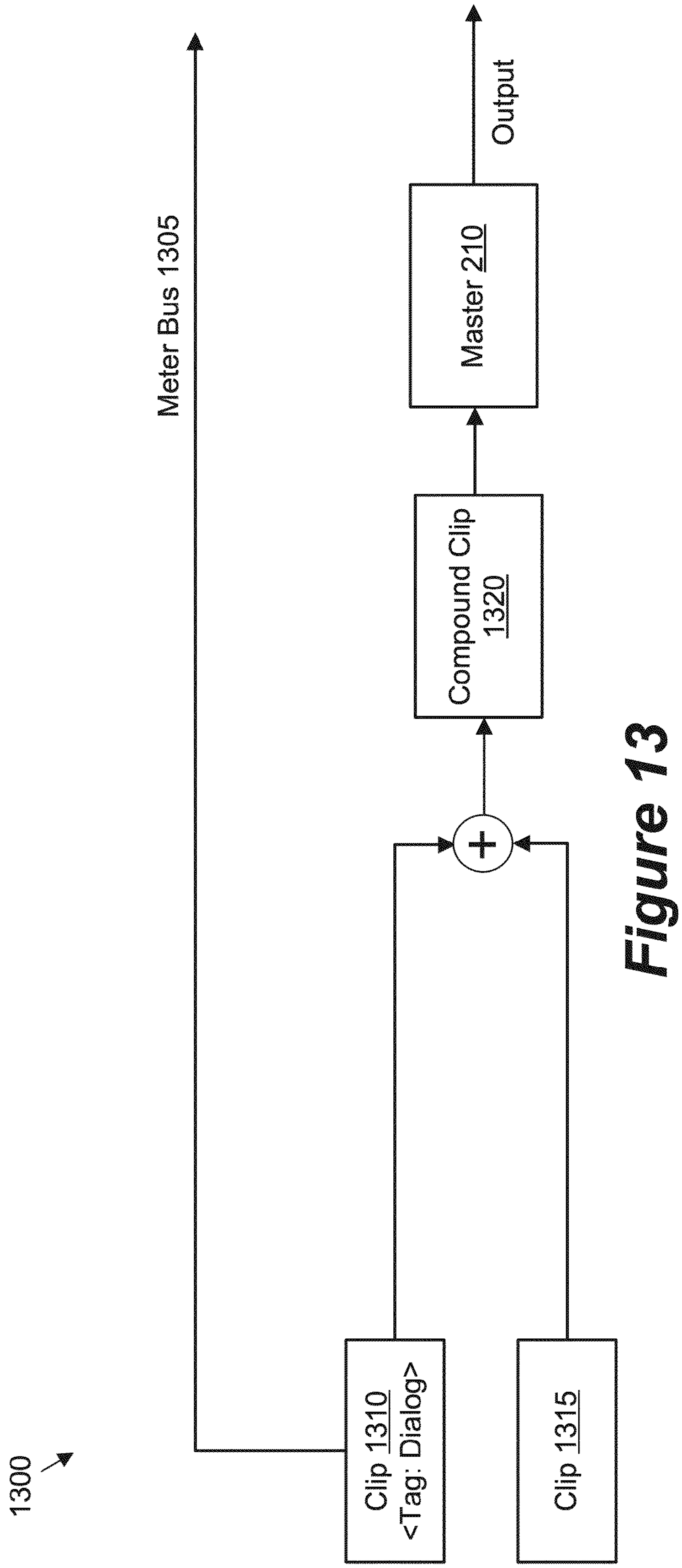

1300
Clip 1310
<Tag: Dialog>
Clip 1315
Meter Bus 1305
Compound Clip
1320
Master 210
Output

Figure 13

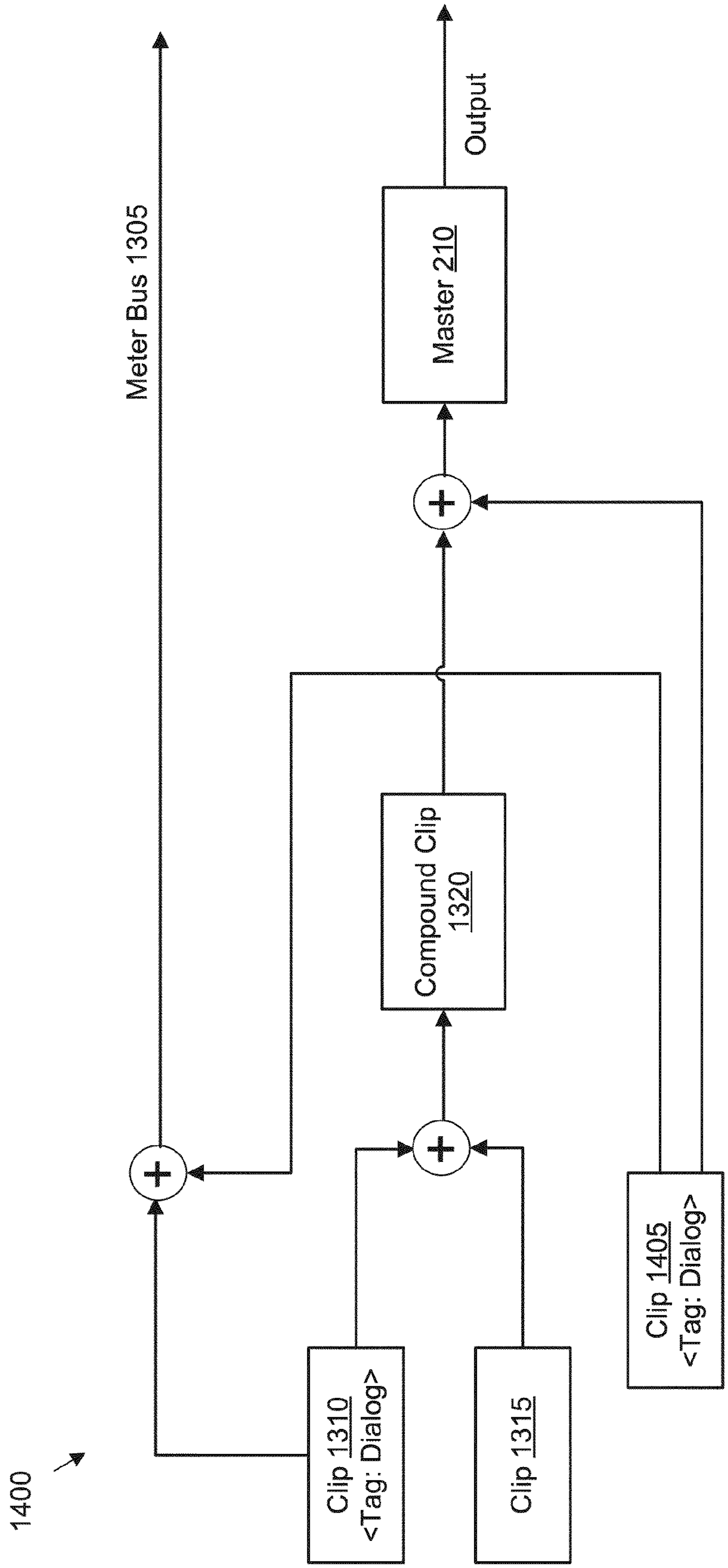

Meter Bus 1305
Output
Master 210
Compound Clip 1320
1400
Clip 1310 <Tag: Dialog>
Clip 1315
Clip 1405 <Tag: Dialog>

Figure 14

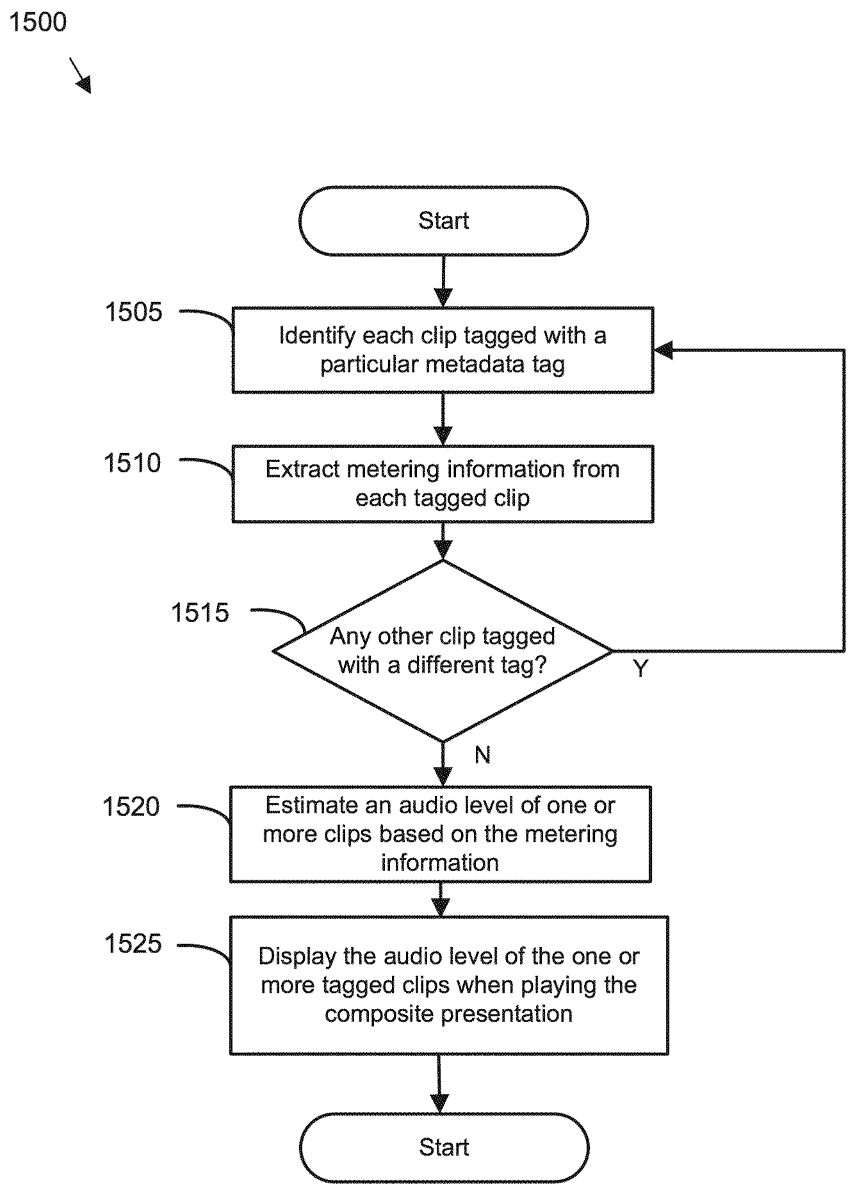

1500
Start
1505
Identify each clip tagged with a particular metadata tag
1510
Extract metering information from each tagged clip
1515
Any other clip tagged with a different tag?
Y
N
1520
Estimate an audio level of one or more clips based on the metering information
1525
Display the audio level of the one or more tagged clips when playing the composite presentation
Start

Figure 15

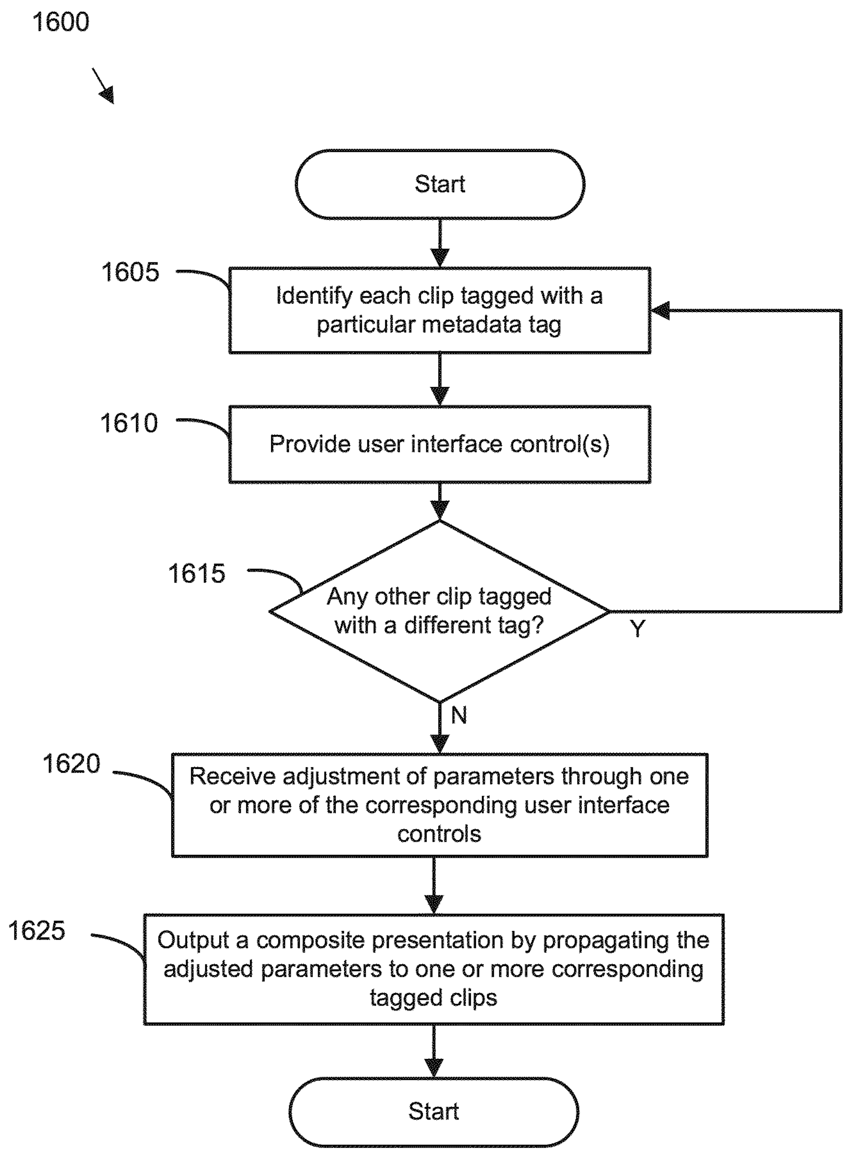

1600
Start
1605
Identify each clip tagged with a particular metadata tag
1610
Provide user interface control(s)
1615
Any other clip tagged with a different tag?
Y
N
1620
Receive adjustment of parameters through one or more of the corresponding user interface controls
1625
Output a composite presentation by propagating the adjusted parameters to one or more corresponding tagged clips
Start

Figure 16

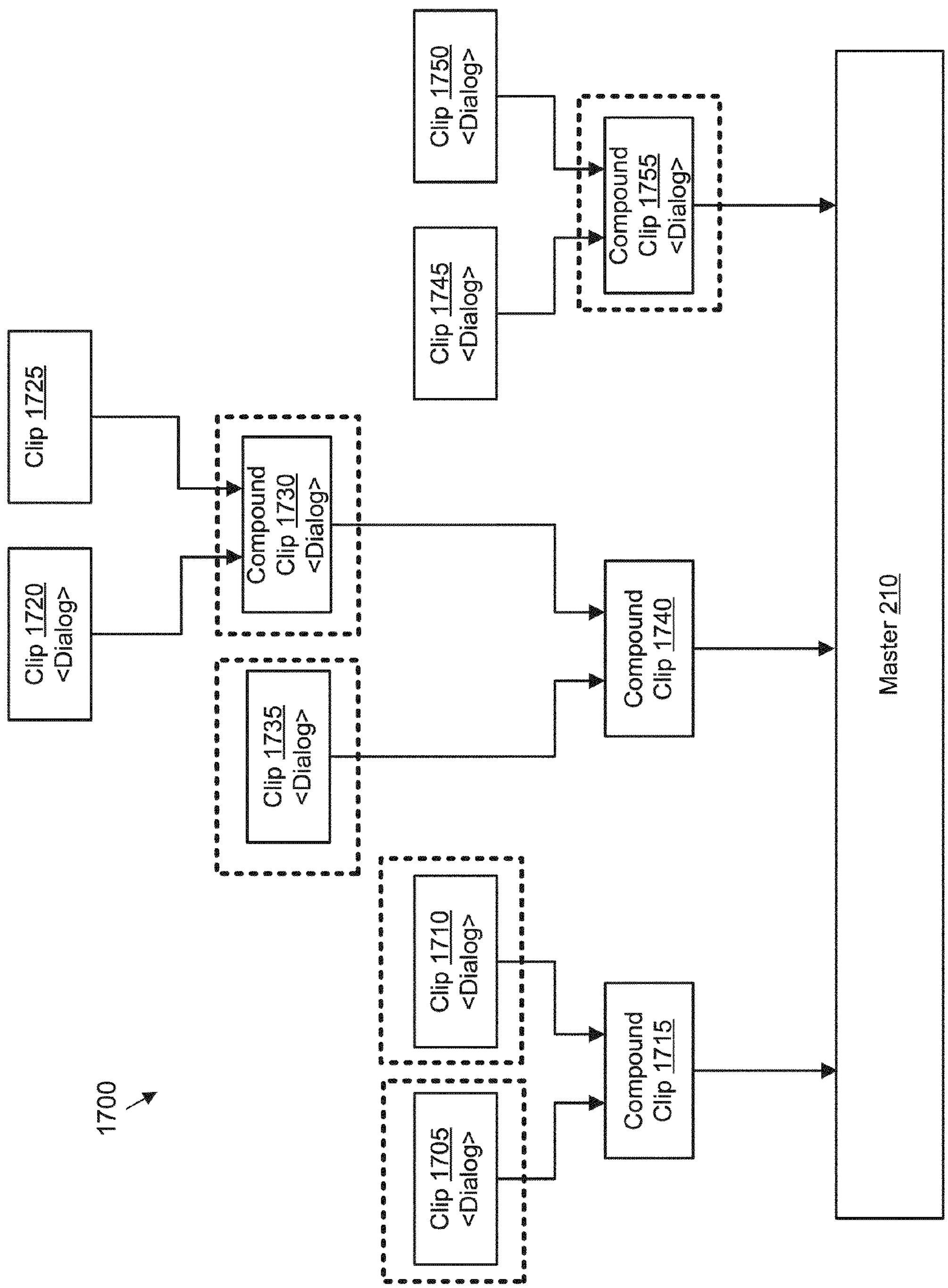
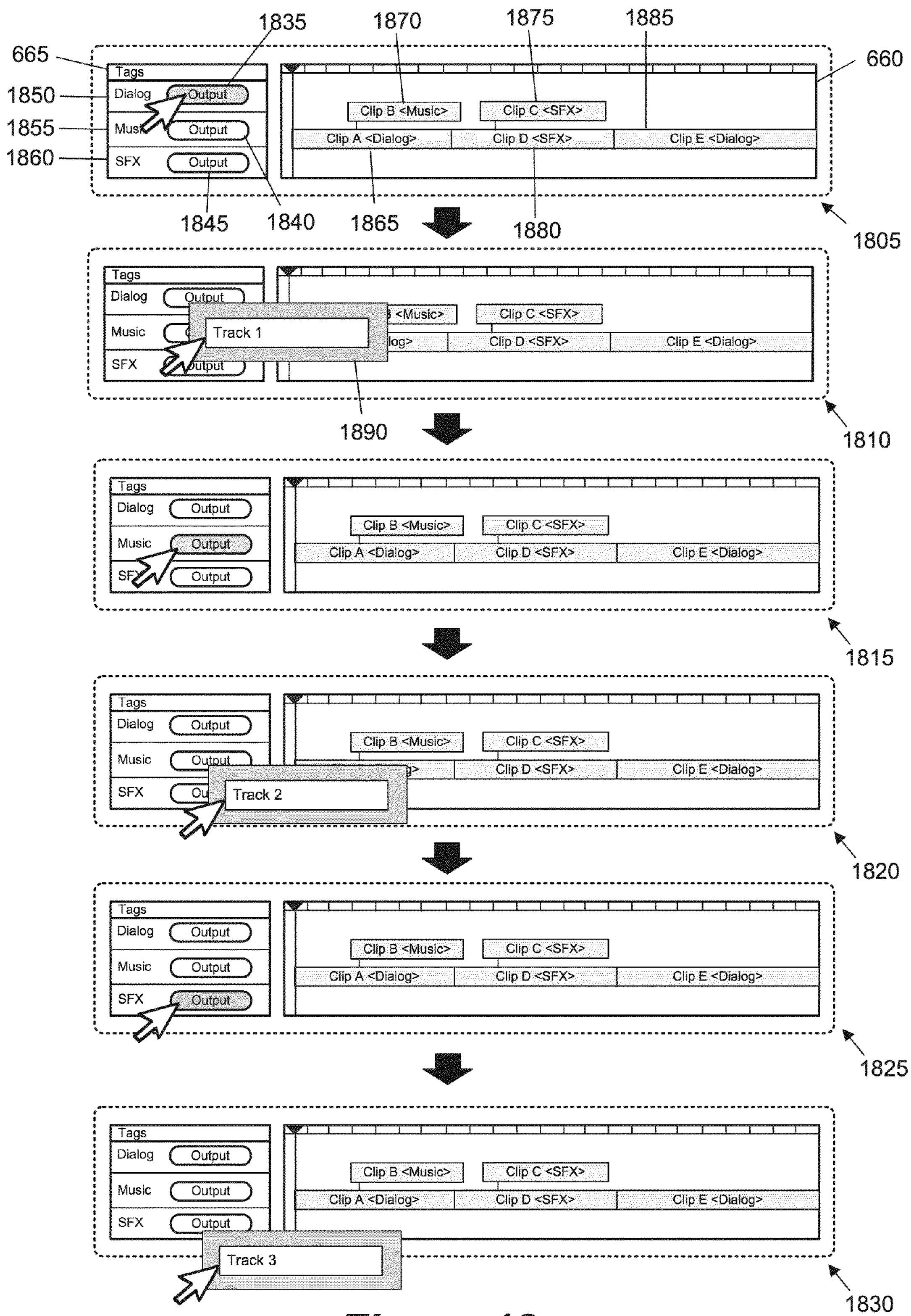

1700
Clip 1705 <Dialog>
Clip 1710 <Dialog>
Compound Clip 1715
Clip 1720 <Dialog>
Clip 1725
Compound Clip 1730 <Dialog>
Clip 1735 <Dialog>
Compound Clip 1740
Clip 1745 <Dialog>
Clip 1750 <Dialog>
Compound Clip 1755 <Dialog>
Master 210

Figure 17



665
1835
1870
1875
1885
660
1850
1855
1860
Tags
Dialog
Music
SFX
Output
Clip B <Music>
Clip C <SFX>
Clip A <Dialog>
Clip D <SFX>
Clip E <Dialog>
1845
1840
1865
1880
1805
Track 1
1890
1810
1815
Track 2
1820
1825
Track 3
1830

Figure 18

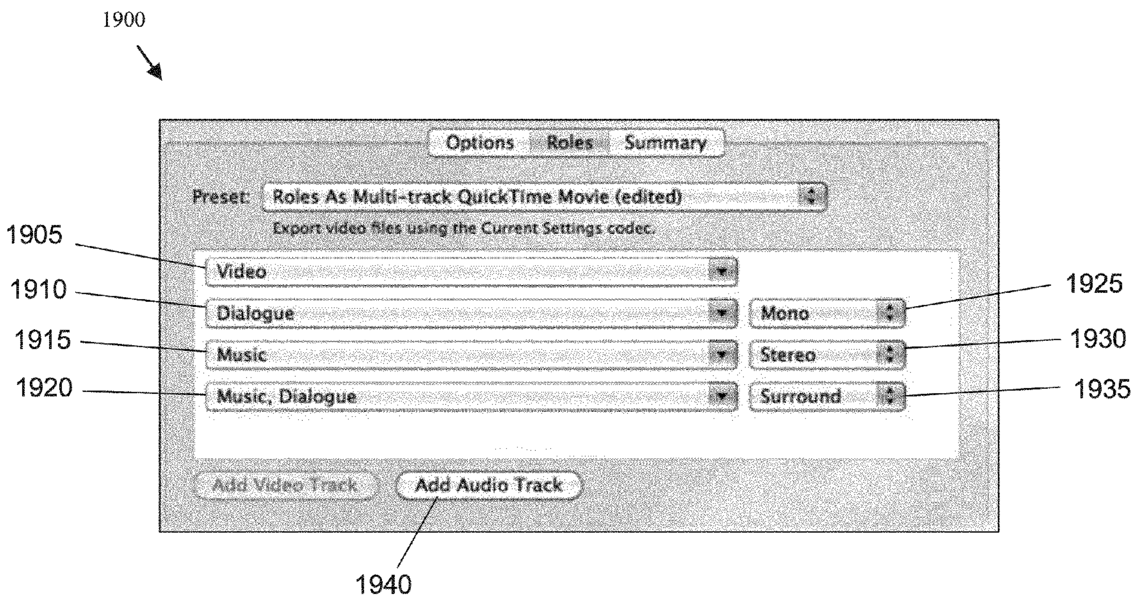

1900
Options
Roles
Summary
Preset:
Roles As Multi-track QuickTime Movie (edited)
Export video files using the Current Settings codec.
1905
Video
1910
Dialogue
Mono
1925
1915
Music
Stereo
1930
1920
Music, Dialogue
Surround
1935
Add Video Track
Add Audio Track
1940

Figure 19

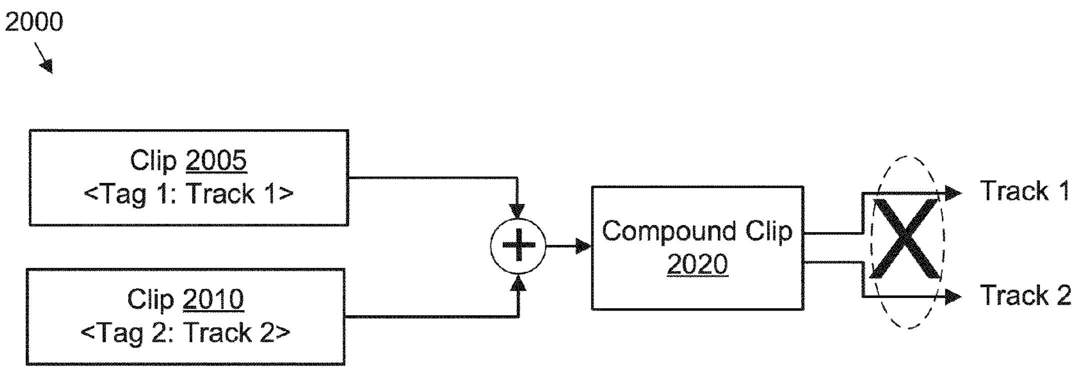


Figure 20A

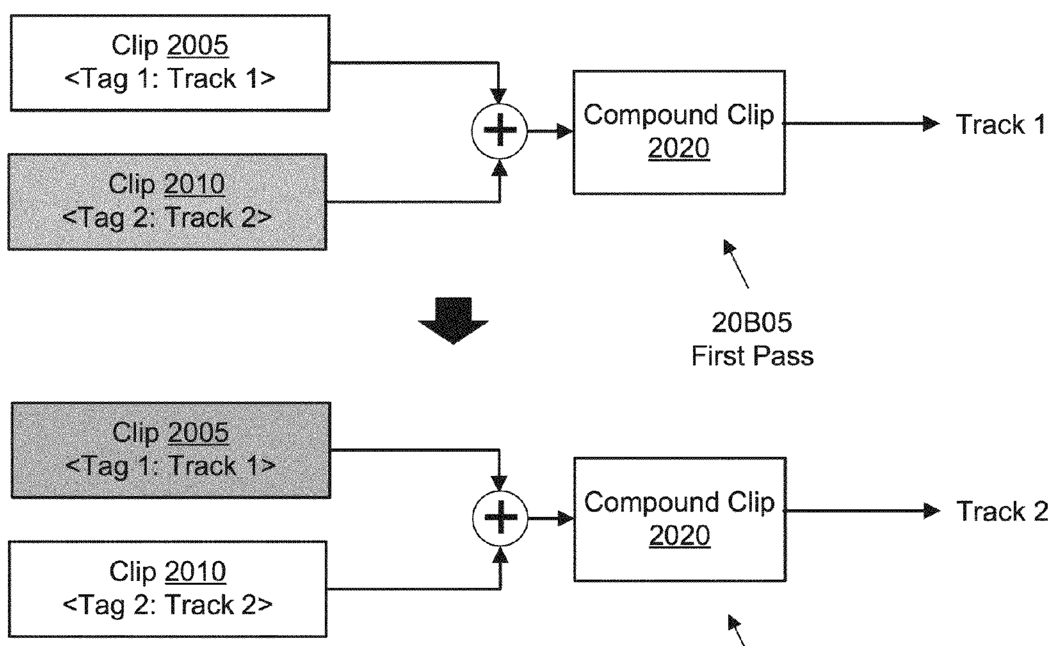


Figure 20B

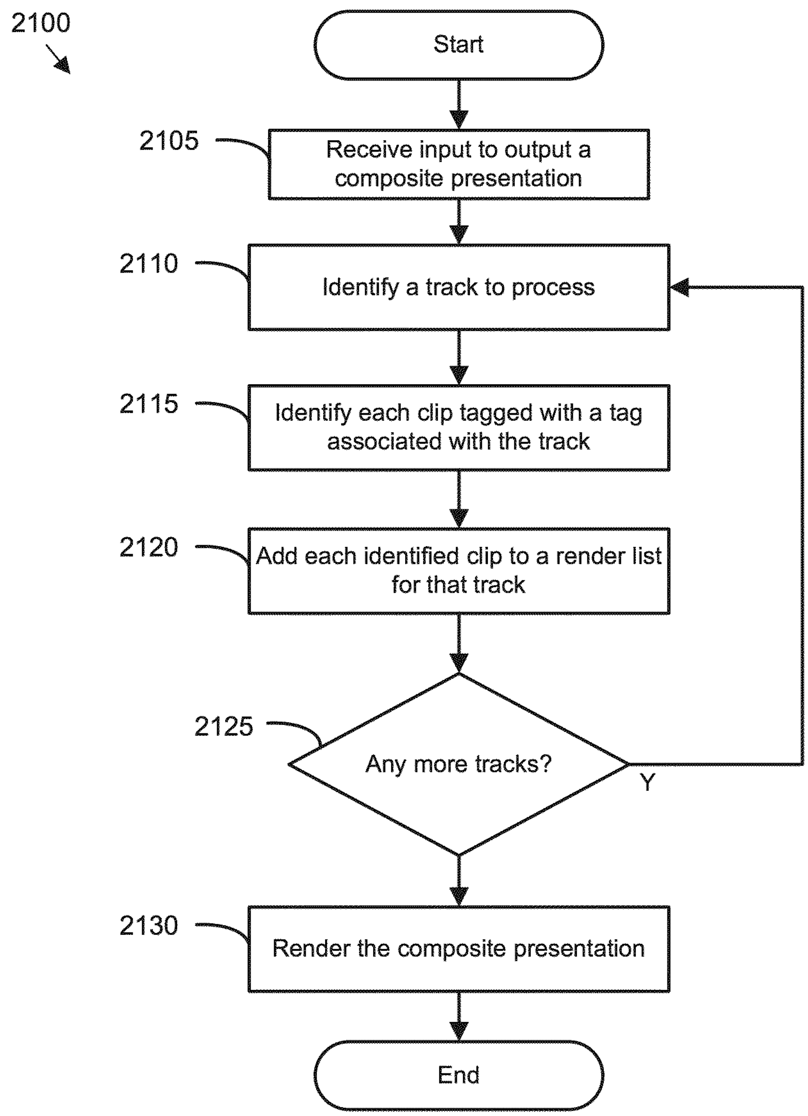

2100
Start
2105
Receive input to output a composite presentation
2110
Identify a track to process
2115
Identify each clip tagged with a tag associated with the track
2120
Add each identified clip to a render list for that track
2125
Any more tracks?
Y
2130
Render the composite presentation
End

Figure 21

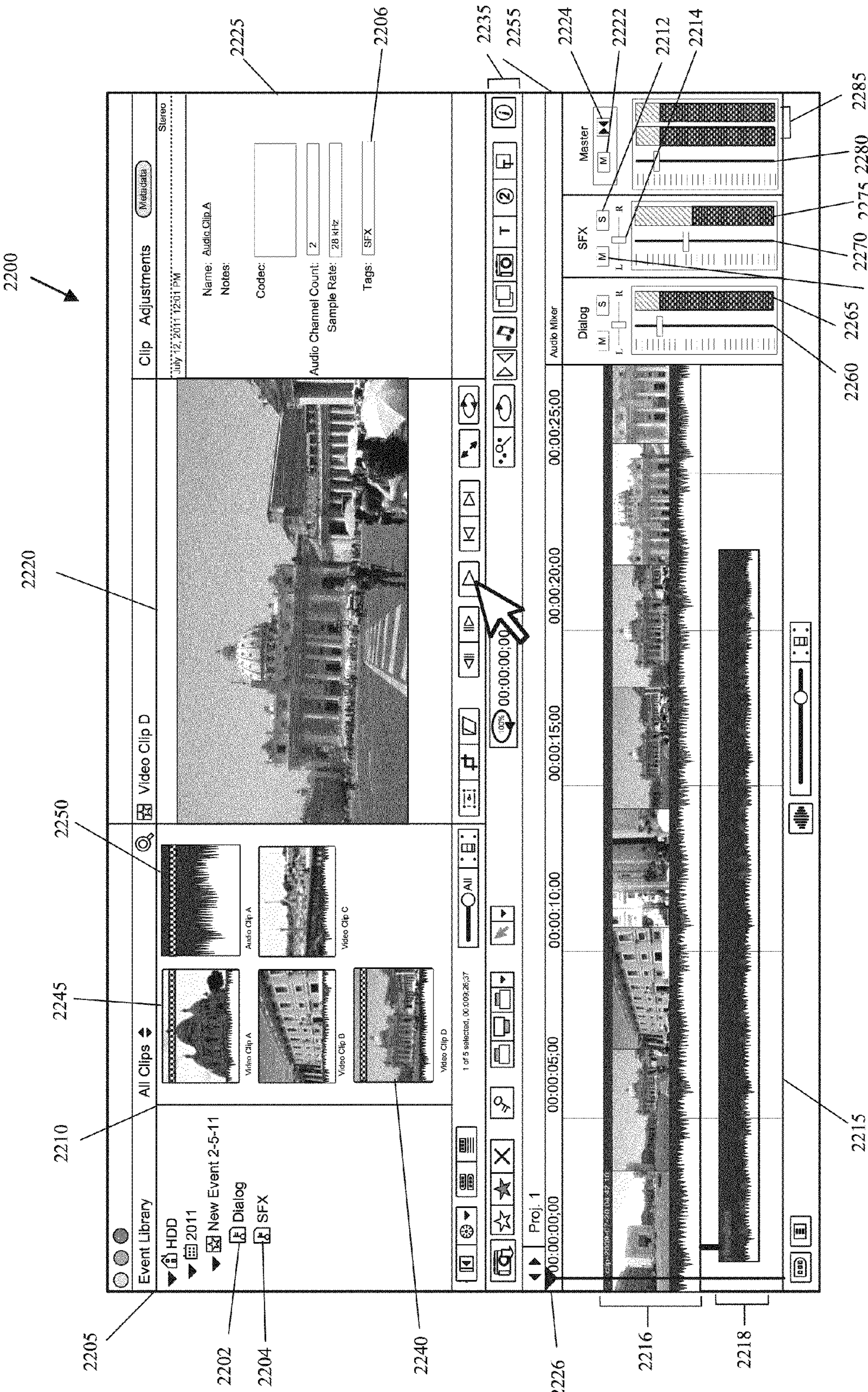

2200
2205
2202
2204
2240
2226
2216
2218
2210
2245
2250
2220
2225
2206
2235
2255
2224
2222
2212
2214
2285
2280
2275
2270
2208
2265
2260
2215
Event Library
HDD
2011
New Event 2-5-11
Dialog
SFX
All Clips
Video Clip A
Video Clip B
Video Clip D
Audio Clip A
Video Clip C
1 of 5 selected, 00:009:26;37
All
Video Clip D
Clip
Adjustments
Metadata
Stereo
July 12, 2011 12:01 PM
Name: Audio Clip A
Notes:
Codec:
Audio Channel Count: 2
Sample Rate: 28 kHz
Tags: SFX
00:00:00;00
Proj. 1
00:00:00;00
00:00:05;00
00:00:10;00
00:00:15;00
00:00:20;00
00:00:25;00
Audio Mixer
Dialog
SFX
Master
M
S
L
R

Figure 22

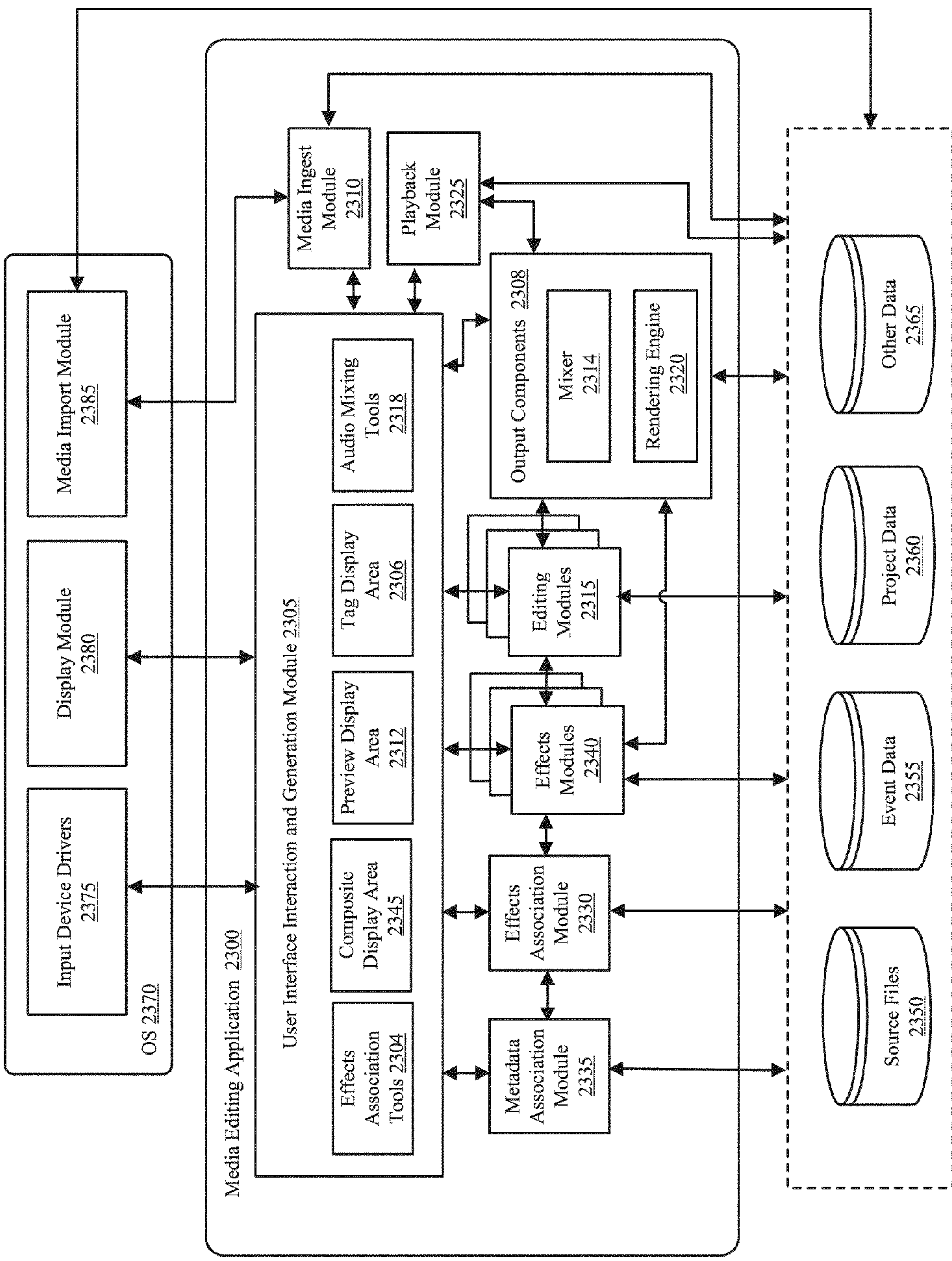

OS 2370
Input Device Drivers 2375
Display Module 2380
Media Import Module 2385
Media Editing Application 2300
User Interface Interaction and Generation Module 2305
Effects Association Tools 2304
Composite Display Area 2345
Preview Display Area 2312
Tag Display Area 2306
Audio Mixing Tools 2318
Media Ingest Module 2310
Playback Module 2325
Output Components 2308
Mixer 2314
Rendering Engine 2320
Editing Modules 2315
Effects Modules 2340
Effects Association Module 2330
Metadata Association Module 2335
Source Files 2350
Event Data 2355
Project Data 2360
Other Data 2365

Figure 23

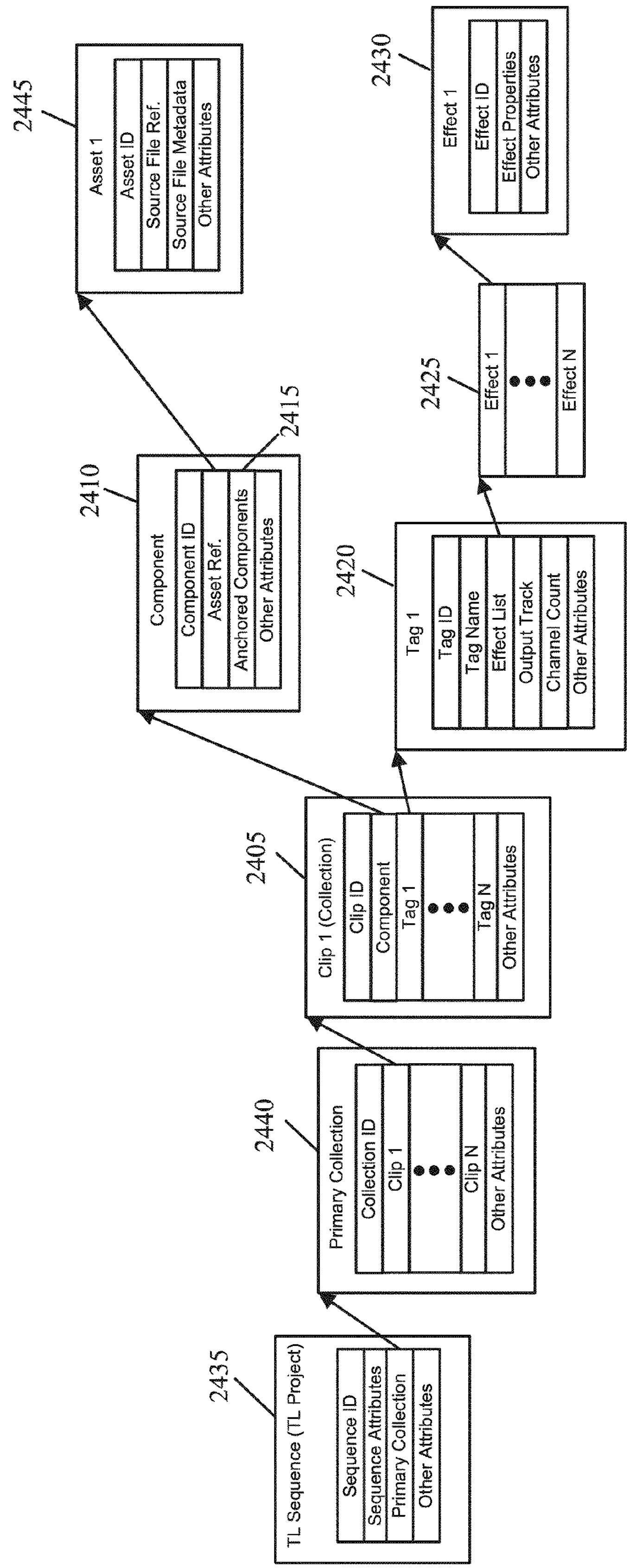

2445
Asset 1
Asset ID
Source File Ref.
Source File Metadata
Other Attributes
2430
Effect 1
Effect ID
Effect Properties
Other Attributes
2425
Effect 1
Effect N
2415
2410
Component
Component ID
Asset Ref.
Anchored Components
Other Attributes
2420
Tag 1
Tag ID
Tag Name
Effect List
Output Track
Channel Count
Other Attributes
2405
Clip 1 (Collection)
Clip ID
Component
Tag 1
Tag N
Other Attributes
2440
Primary Collection
Collection ID
Clip 1
Clip N
Other Attributes
2435
TL Sequence (TL Project)
Sequence ID
Sequence Attributes
Primary Collection
Other Attributes

Figure 24

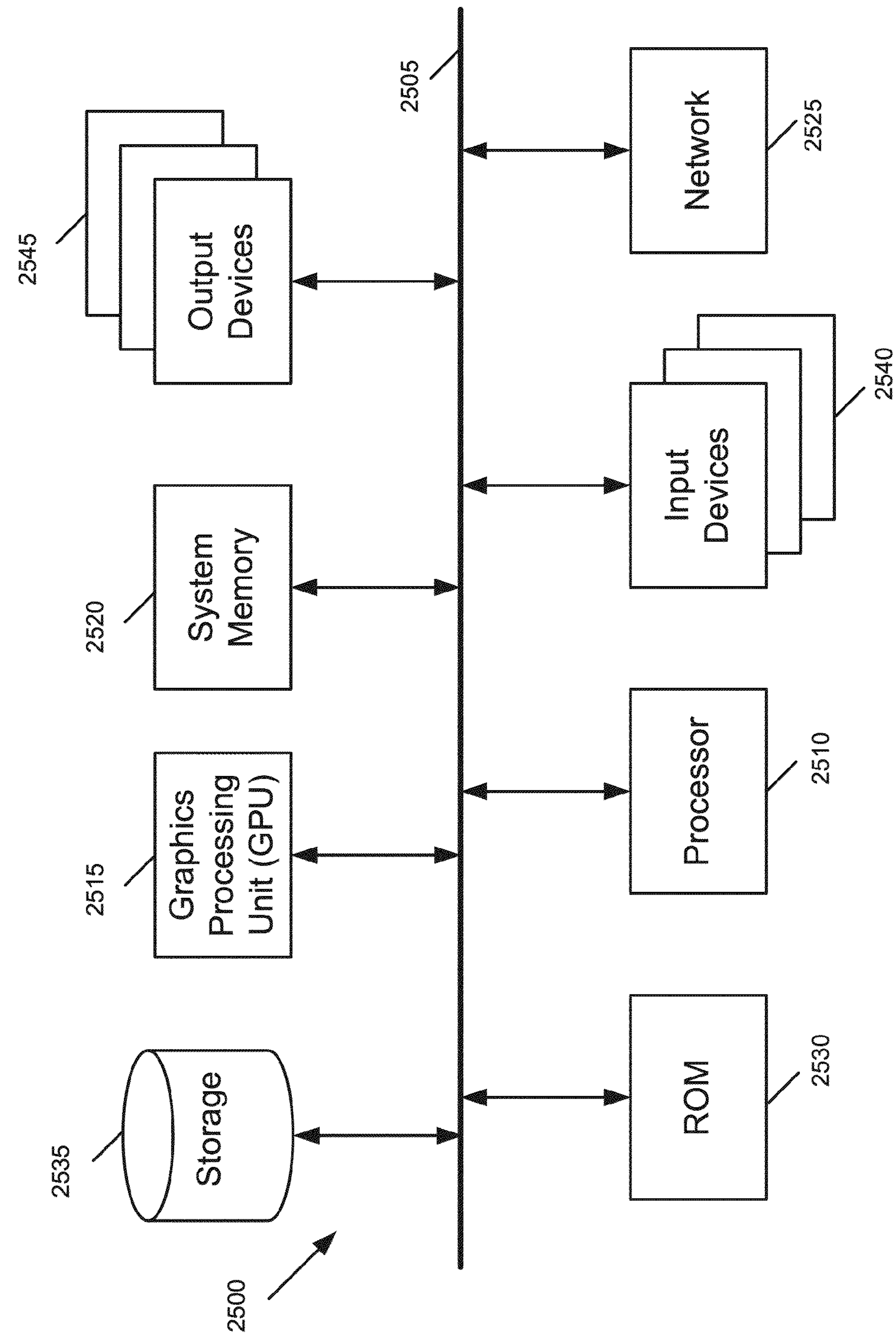

2545
Output Devices
2505
Network
2525
2520
System Memory
Input Devices
2540
2515
Graphics Processing Unit (GPU)
Processor
2510
2535
Storage
ROM
2530
2500

Figure 25

EDITING OPERATIONS FACILITATED BY METADATA

CLAIM OF BENEFIT TO PRIOR APPLICATIONS

This application claims the benefit of U.S. Provisional Application 61/537,041, filed Sep. 20, 2011, and U.S. Provisional Application 61/537,567, filed Sep. 21, 2011. U.S. Provisional Application 61/537,041 and U.S. Provisional Application 61/537,567 are incorporated herein by reference.

BACKGROUND

To date, many media editing applications exist for creating a composite media presentation by compositing several pieces of media content such as video, audio, animation, still image, etc. In some cases, a media editing application combines a composite of two or more clips with one or more other clips to output (e.g., play, export) the composite presentation.

There are a number of different problems that can occur when outputting such a composite presentation. For example, some movie studios require a particular content (e.g., dialog content, music content) of a composite presentation to be separate from other content. The content separation allows the movie studios to easily replace the composite presentation's dialog in one language with a dialog in another language. The problem with providing separate content is that, once several pieces of media content are mixed as one mixed content, the mixed content cannot be un-mixed to provide the separate content.

As another example, displaying the audio levels of different media clips during playback of a composite presentation is useful as the audio levels indicate how much audio one or more of the different media clips are contributing to the overall mix. The problem with this is similar to the example described above. That is, a mix of the different media clips cannot be un-mixed during playback to provide metering information for the different media clips.

In addition, some media editing applications apply one or more different effects (e.g., reverb effect, echo effect, blur effect, distort effect, etc.) to a set of clips when outputting a composite presentation. Several of these effects are applied using a "send" (i.e., "send and return") that entails routing audio signals of different clips over an auxiliary ("aux") bus to an effects unit. For a typical media editing application, a "send" effect is applied with the user manually adding an input aux track, specifying an effect for the aux track, specifying an input bus for the aux track, creating the "send", and identifying the specified bus to route the audio signals of different clips. In this manner, several audio signals of different clips can be routed over one aux bus in order to apply a same effect (e.g., an echo effect) to a combined audio signal of the different clips. However, the "send" technique becomes increasingly complicated as additional aux buses are added to route audio signals of multiple different clips.

Furthermore, several of the media editing applications described above allow users to view metadata associated with media content and/or perform organizing operations using the metadata. However, these media editing applications lack the tools or the functionality to perform different editing operations by using one or more pieces of metadata that is associated with the media content.

The concepts described in this section have not necessarily been previously conceived, or implemented in any prior approach. Therefore, unless otherwise indicated, it should not be assumed that any concepts described in this section qualify as prior art merely by virtue of their inclusion in this section.

BRIEF SUMMARY

Some embodiments provide a media editing application that uses metadata or metadata tags associated with media content to facilitate editing operations. In some embodiments, the editing operations are performed on the media content at various different stages of the editing process in order to create a composite presentation. In creating the composite presentation, one or more effects are associated with a metadata tag. Once the effects are associated, the media editing application applies the effects to different pieces of media content tagged with the metadata tag in order to create the composite presentation.

Different embodiments provide different schemes for specifying one or more effects to apply to media content that have been associated with a metadata tag. For instance, in some embodiments, the media editing application allows an effect chain or an effect list to be specified for each type or category of metadata tag. In some embodiments, the media editing application allows its user to specify effect properties for the effects in the effect list. These effect properties define how the corresponding effect is applied to the media content.

Based on metadata associated with different clips, the media editing application of some embodiments applies a set of effects (e.g., echo effect, reverb effect) by using a "send" or a "send and return". In some embodiments, the "send" is performed automatically such that the routing of audio signals of the different clips to an effect module is transparent to the application's user. That is, the user does not have to add an input auxiliary ("aux") track, specify an effect for the aux track, specify an input bus for the aux track, create the "send", and identify the specified bus to route the audio signals of the different clips. Instead, the user can simply specify a particular effect for a metadata tag. The media editing application then applies the particular effect using the "send" to a combined audio signal of each clip tagged with the metadata tag.

The media editing application of some embodiments applies one or more effects directly on each clip without using the "send". One example of such technique is applying an effect as an "insert" effect that processes (e.g., filters, distorts) an incoming audio signal and outputs the processed audio signal. For example, when a metadata tag is associated with a particular effect, the media editing application of some embodiments automatically applies the particular effect to each audio signal of the different clips tagged with the metadata tag.

In some embodiments, when playing a composite presentation, the media editing application displays the audio level of a set of one or more clips that has been mixed with other clips. For example, the audio signals of the set of clips can be mixed with other clips in order to play the composite presentation. To indicate the audio level of the set of clips that has been mixed with other clips, the media editing application of some embodiments routes a combined audio signal of the set of clips over a meter bus in order to determine the audio level of the combined audio signal. In some embodiments, the media editing application scales (i.e., reduces or increases) the audio level of one or more clips by processing down a signal chain or sequence of operations and identifying what one or more of the clips are contributing to the overall mix.

Alternatively, the media editing application of some embodiments extracts metering information from each clip in a set of clips prior to mixing the clips. The metering information is then used to estimate the audio level of one or more clips in the composite presentation. Similar to sending the audio signal over the meter bus, the media editing application of some embodiments scales the estimated audio level by identifying what one or more of the clips are contributing to the overall mix.

In some embodiments, the media editing application allows a composite presentation to be exported to different tracks (e.g., different files). To export the composite presentation, the media editing application of some embodiments performs multiple rendering passes on a sequence of clips while muting one or more of the clips in the sequence. In some such embodiments, the composite presentation is output to different tracks based on metadata associated with the clips. For example, with these metadata tags, a multi-track output can be specified as a first track for each clip tagged as dialog, a second track for each clip tagged as music, etc. In this manner, the editor or a movie studio can easily replace one track with another track.

The media editing application of some embodiments uses metadata to provide user interface controls. In some such embodiments, these controls are used to display properties of tagged clips and/or specify parameters that affect the tagged clips. Example of such user interface controls include audio meters, volume controls, different controls for modifying (e.g., distorting, blurring, changing color) images, etc.

The preceding Summary is intended to serve as a brief introduction to some embodiments of the invention. It is not meant to be an introduction or overview of all inventive subject matter disclosed in this document. The Detailed Description that follows and the Drawings that are referred to in the Detailed Description will further describe the embodiments described in the Summary as well as other embodiments. Accordingly, to understand all the embodiments described by this document, a full review of the Summary, Detailed Description and the Drawings is needed. Moreover, the claimed subject matters are not to be limited by the illustrative details in the Summary, Detailed Description, and the Drawings, but rather are to be defined by the appended claims, because the claimed subject matters can be embodied in other specific forms without departing from the spirit of the subject matters.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features of the invention are set forth in the appended claims. However, for purpose of explanation, several embodiments of the invention are set forth in the following figures.

FIG. **1** conceptually illustrates a process that some embodiments use to apply effects.

FIG. **2** shows a signal flow diagram that conceptually illustrates how some embodiments apply the reverb effect.

FIG. **3** shows a signal flow diagram of some embodiments that conceptually illustrates application of an effect on multiple clips.

FIG. **4** shows a signal flow diagram that conceptually illustrates how some embodiments apply an effect chain with multiple different effects.

FIG. **5** shows a signal flow diagram that conceptually illustrates how some embodiments apply a particular effect or a particular filter as an insert effect.

FIG. **6** illustrates an example of specifying an effect for a compound clip.

FIG. **7** shows a signal flow diagram of some embodiments that conceptually illustrates the application of the reverb effect on the compound clip.

FIG. **8** shows a signal flow diagram of some embodiments that conceptually illustrates the application of the reverb effect on an inner clip of a compound clip.

FIG. **9** shows a signal flow diagram that conceptually illustrates how some embodiments route a combined audio signal of several clips over a particular aux bus based on the clips' association with a metadata tag.

FIG. **10** conceptually illustrates a process that some embodiments use to apply one or more effects to a compound clip and/or the compound clip's nested clips.

FIG. **11** illustrates an example of how some embodiments perform editing operations based a compound clip's tag.

FIG. **12** illustrates example meters that indicate audio levels of several clips that have been mixed with other clips.

FIG. **13** shows a signal flow diagram that conceptually illustrates sending an audio signal of a clip over a meter bus in order to display the clip's audio level during playback of a mixed audio signal of a composite presentation.

FIG. **14** shows a signal flow diagram that conceptually illustrates routing a combined audio signal of several clips over a meter bus for the purposes of displaying the clips' audio level.

FIG. **15** conceptually illustrates a process that some embodiments use to estimate audio levels of clips that are tagged with metadata tags.

FIG. **16** conceptually illustrates a process that some embodiments use to construct user interface controls based on metadata tags.

FIG. **17** shows a data flow diagram that conceptually illustrates an example of adjusting parameters of several clips at different levels of a hierarchy, in some embodiments.

FIG. **18** illustrates how some embodiments output audio content to different tracks based on metadata that is associated with different clips.

FIG. **19** provides an illustrative example of an output tool for the media editing application.

FIG. **20**A illustrates the problem with outputting a composite presentation to different tracks.

FIG. **20**B illustrates outputting a composite presentation to different audio files, in some embodiments.

FIG. **21** conceptually illustrates a process that some embodiments use to output a composite presentation based on metadata tags associated with one or more output tracks.

FIG. **22** illustrates a graphical user interface of a media editing application of some embodiments.

FIG. **23** conceptually illustrates the software architecture of a media editing application of some embodiments.

FIG. **24** conceptually illustrates example data structures for several objects associated with a media editing application of some embodiments.

FIG. **25** illustrates an electronic system with which some embodiments of the invention are implemented.

DETAILED DESCRIPTION

In the following detailed description of the invention, numerous details, examples, and embodiments of the invention are set forth and described. However, it will be clear and apparent to one skilled in the art that the invention is not limited to the embodiments set forth and that the invention may be practiced without some of the specific details and examples discussed.

Some embodiments provide a media editing application that uses metadata or metadata tags associated with media content to facilitate editing operations. In some embodiments, the editing operations are performed on the media content at various different stages of the editing process in order to create a composite presentation. In creating the composite presentation, one or more effects are associated with a metadata tag. Once the effects are associated, the media editing application applies the effects to different pieces of media content tagged with the metadata tag in order to create the composite presentation.

Different embodiments provide different schemes for specifying one or more effects to apply to media content that have been associated with a metadata tag. For instance, in some embodiments, the media editing application allows an effect chain or an effect list to be specified for each type or category of metadata tag. In some embodiments, the media editing application allows its user to specify effect properties for the effects in the effect list. These effect properties define how the corresponding effect is applied to the media content.

Based on metadata associated with different clips, the media editing application of some embodiments applies a set of effects (e.g., echo effect, reverb effect) by using a "send" or a "send and return". In some embodiments, the "send" is performed automatically such that the routing of audio signals of the different clips to an effect module is transparent to the application's user. That is, the user does not have to add an input auxiliary ("aux") track, specify an effect for the aux track, specify an input bus for the aux track, create the "send", and identify the specified bus to route the audio signals of the different clips. Instead, the user can simply specify a particular effect for a metadata tag. The media editing application then applies the particular effect using the "send" to a combined audio signal of each clip tagged with the metadata tag.

The media editing application of some embodiments applies one or more effects directly on each clip without using the "send". One example of such technique is applying an effect as an "insert" effect that processes (e.g., filters, distorts) an incoming audio signal and outputs the processed audio signal. For example, when a metadata tag is associated with a particular effect, the media editing application of some embodiments automatically applies the particular effect to each audio signal of the different clips tagged with the metadata tag.

In some embodiments, when playing a composite presentation, the media editing application displays the audio level of a set of one or more clips that has been mixed with other clips. For example, the audio signals of the set of clips can be mixed with other clips in order to play the composite presentation. To indicate the audio level of the set of clips that has been mixed with other clips, the media editing application of some embodiments routes a combined audio signal of the set of clips over a meter bus in order to determine the audio level of the combined audio signal. In some embodiments, the media editing application scales (i.e., reduces or increases) the audio level of one or more clips by processing down a signal chain or sequence of operations and identifying what one or more of the clips are contributing to the overall mix.

Alternatively, the media editing application of some embodiments extracts metering information from each clip in a set of clips prior to mixing the clips. The metering information is then used to estimate the audio level of one or more clips in the composite presentation. Similar to sending the audio signal over the meter bus, the media editing application of some embodiments scales the estimated audio level by identifying what one or more of the clips are contributing to the overall mix.

In some embodiments, the media editing application allows a composite presentation to be exported to different tracks (e.g., different files). To export the composite presentation, the media editing application of some embodiments performs multiple rendering passes on a sequence of clips while muting one or more of the clips in the sequence. In some such embodiments, the composite presentation is output to different tracks based on metadata associated with the clips. For example, with these metadata tags, a multi-track output can be specified as a first track for each clip tagged as dialog, a second track for each clip tagged as music, etc. In this manner, the editor or a movie studio can easily replace one track with another track.

The media editing application of some embodiments uses metadata to provide user interface controls. In some such embodiments, these controls are used to display properties of tagged clips and/or specify parameters that affect the tagged clips. Example of such user interface controls include audio meters, volume controls, different controls for modifying (e.g., distorting, blurring, changing color) images, etc.

Several more examples editing operations are described below. Section I describes several examples of applying effects to different tagged clips. Section II then introduces compound clips and proves several examples of applying effects to the compound clips. Section III then describes examples of metering clips that has previously been mixed. Section IV then describes constructing user interface controls and propagating parameters specified through the user interface controls. Section V then describes using metadata tags to output a composite presentation to different tracks. Section VI describes an example graphical user interface and software architecture of a media editing application of some embodiments. Section VI also describes several example data structures for the media editing application of some embodiments. Finally, Section VII describes an electronic system which implements some embodiments of the invention.

I. Applying Effects to Clips Based on Metadata

In some embodiments, the media editing application applies one or more effects to clips in a composite presentation based on metadata (i.e., metadata tags) associated with the clips. In creating the composite presentation, one or more effects are associated with a metadata tag. Once the effects are associated, the media editing application applies the effects to different pieces of media content tagged with the metadata tag in order to create the composite presentation.

There are many different effects or filters that can be associated with metadata to facilitate editing operations. Although this list is non-exhaustive, several example audio effects include an equalizer for modifying the signal strength of a clip within specified frequency ranges, an echo effect for creating an echo sound, and a reverb effect for creating a reverberation effect that emulates a particular acoustic environment. Several example video effects or image effects include color filters that operate on color values, different filters that sharpen, stylize, distort, or blur an image, and fade-in/fade-out effects for creating transitions between scenes.

FIG. **1** conceptually illustrates a process **100** that some embodiments use to apply effects to different clips based on metadata. Specifically, this figure illustrates process **100** that applies effects to the different clips in a composite presentation when outputting the composite presentation. In some embodiments, process **100** is performed by a media editing application. This process **100** will be described by reference to FIGS. **3-5** that illustrate application of effects on a set of clips based on the association of the effects to metadata and the association of the metadata to the set of clips.

As shown, process **100** identifies (at **105**) each clip tagged with a particular metadata tag having an associated effect. FIG. **2** shows a signal flow diagram **200** that conceptually illustrates application of an effect. Specifically, the signal flow diagram **200** illustrates an example of how the audio signal of a clip **215** is routed to output a mixed audio signal with a specified reverb effect. As shown, the figure includes the clip **215**, a master **210**, and a reverb effect ("FX") module **205**. The reverb FX module **205** receives an audio signal of one or more clips, applies the reverb effect to the received audio signal, and outputs an audio signal containing the reverb effect. The master **210** defines the output audio level of a composite presentation.

In example illustrated in FIG. **2**, process **100** identifies the clip **215** as a clip tagged with a "Dialog" tag having an associated effect. In some embodiments, the identification is initiated based on user input to output a composite presentation based on a sequence of clips that define the composite presentation. Alternatively, in some embodiments, the media editing application performs rendering and/or mixing operations in the background in order to output the composite presentation (e.g., to play a preview of the composite presentation in real-time).

Process **100** then identifies (at **110**) the effect that is associated with the particular metadata tag. As shown FIG. **2**, the clip **215** is associated with a "Dialog" tag. This piece of metadata is associated with a reverb effect. Process **100** then determines (at **115**) whether the effect requires data of one or more clips to be routed to one effect creation unit (e.g., by using send and return).

When the effect does not requires data of one or clips to be routed, process **100** proceeds to **120** which is described below. Otherwise, process **100** process **100** defines (at **135**) a bus for the particular metadata tag. In some embodiments, the process creates this bus to send a combined audio signal of each clip tagged with the particular metadata tag. In the example illustrated in FIG. **2**, an aux send bus is defined to send an audio signal of each clip tagged with the "Dialog tag".

Process **100** then sends (at **140**) an audio signal of each identified clip over the aux send bus. Process **100** identifies (at **145**) parameters of the identified effect. Different effects can be associated with different parameters. For example, a reverb effect can have one set of parameters including the output audio level of the reverberation effect, the type of reverberation (e.g., room, hall, space), etc. Different from the reverb effect, an image distortion effect can have a different set of settings or parameters for distorting images.

The process **100** then applies (at **150**) the effect to each identified clip based on the identified parameters. As shown in FIG. **2**, the clip **215** is tagged with a "Dialog" tag. This "Dialog" tag is associated with a reverb effect. Based on the association, the reverb effect is applied to the clip **205** using the send and return. Specifically, the audio signal of the clip **215** is routed to the reverb FX module **205**. The audio signal of is directly routed to the master **210**. The reverb FX module **205** then applies the reverb effect to the received audio signal and returns an audio signal containing the reverb effect to the master **210**. The "+" symbol in this and other figures indicates that audio signals are being combined (i.e., mixed, summed). Hence, the master **210** receives the mixed audio signal and outputs a resulting mixed audio signal for the composite presentation.

In the example illustrated in FIG. **2**, the audio signal of the clip **215** and the audio signal containing the reverb effect are mixed because a reverb effect represents one type of effect that typically mixes back in the original audio signal. An echo effect is another example of such type of effect. For example, the output of the reverb FX module **205** for a clip with dialog is the reverberation of that dialog (e.g., in a theatre, in a hallway). Therefore, the audio signal of the clip is mixed back in such that the audience can hear the dialog and not just the reverberation of that dialog.

In the example illustrated in FIG. **2**, the routing of the audio signal to the reverb effect module **205** is transparent to the application's user. The user does not have to add an auxiliary track, insert the reverb effect to the auxiliary track, specify a bus for the auxiliary track, etc. The user can simply associate the clip's metadata tag with the reverb effect. The media editing application then automatically applies the reverb effect to the clip **215** using the "send and return".

One reason for utilizing the "send" technique is that it allows a combined audio signal of multiple clips to be processed through the same effects unit. In most cases, the "send" operation is used to efficiently process multiple audio signals as one composite audio signal. In other words, as multiple audio signals are mixed and processed together, the "send" technique can be less computationally expensive than applying an effect to each individual audio signal.

FIG. **3** shows a signal flow diagram **300** that conceptually illustrates an example of applying an effect to multiple different clips. Specifically, this figure illustrates an example of how audio signals of clips **305-315** are routed to output a mixed audio signal for a composite presentation. As shown, the figure includes clips **305-315**, an echo FX module **305**, and the master **210**. The master **210** is the same as the one described above by reference to FIG. **2**. The echo FX module **305** receives an audio signal of one or more audio clips, applies the echo effect to the received audio signal, and output an audio signal containing the echo effect.

As shown in FIG. **3**, the audio signals of clips **305-310** are sent to the echo FX module **305**. The audio signals of clips **305-315** are sent to the master **210**. The echo FX module **305** receives a mixed audio signal of clips **305-310**, processes the received audio signal, and returns an audio signal containing the echo effect to the master **210**. The master **210** receives a mixed audio signal of clips **305-315** and the audio signal containing echo effect from the echo FX module **305**. The master **210** then outputs a resulting mixed audio signal for the sequence of clips **305-315**. Here, the resulting mixed audio signal is a composite audio signal of clips **305-315** and includes the echo effect applied to clips **305** and **310**. In some embodiments, the duration of this composite audio signal is the duration of the composite presentation.

In the examples described above, one effect is applied to one or more clips. FIG. **4** shows a signal flow diagram **400** that conceptually illustrates applying an effect chain with multiple different effects. In some embodiments, the effect chain represents an ordered sequence or series of effects that is specified for a particular metadata tag and applied to one or more clips tagged with the particular metadata tag.

As show in FIG. **4**, the clip **215** is tagged with the "Dialog" tag, and a chain of effect has been specified for this tag. The chain of effects includes a reverb effect and an echo effect. As the echo effect is being applied to the clip **215**, the signal flow diagram **400** includes an echo FX module **305**.

In the example illustrated in FIG. **4**, the clip's audio signal is first routed to the reverb FX module **205**. This is because the reverb effect is the first effect in the chain of effects. Here, the reverb FX module **205** applies the reverb effect to the incoming audio signal and outputs an audio signal containing the reverb effect. To continue the chain of effects, the audio signal containing the reverb effect is received at the echo FX module **305**. The echo FX module **305** processes the incoming audio signal and outputs a processed audio signal. As indicated by the "+" symbol, the audio signal from the echo FX module **410** is then mixed with the audio signal of the clip **215**. The master **210** receives the mixed audio signal and outputs a resulting mixed audio signal.

Referring back to FIG. **1**, when the effect does not require data of one or more clips to be routed, process **100** identifies (at **120**) properties of the identified effect. As mentioned, different effects can have different properties. For example, an image distortion effect can have one set of parameters for distorting an image, while an echo effect can have another set of parameters for adding the echo to an audio signal.

The process **100** then applies (at **125**) the effect to each identified clip. Specifically, each particular effect is applied to the clip based on the properties of the particular effect. The media editing application of some embodiments applies one or more effects directly on each clip without using the "send". One example of such technique is applying effects as "insert" effects. Different from the "send" effect, an "insert" effect simply processes the incoming audio signal and outputs a processed audio signal. In using this technique, the audio signals of different clips are not routed over an auxiliary bus to an effect module to be processed as one combined audio signal. Also, the output of an effect module is not mixed back in with one or more original audio signals. For example, the output audio data of a filter or an effect that compresses or distorts input audio data does not need to be mixed back in with the original uncompressed or undistorted audio data. Similarly, the output of an equalizer that reduces the bass of a clip does not need be mixed back in with the original clip as it will defeat the purpose of reducing the bass in the first place. Many different audio effects or audio filters (e.g., equalizers, compressors, band-pass filters) are applied as "insert" effects, in some embodiments.

FIG. **5** shows a signal flow diagram **500** that conceptually illustrates compressing audio signals of clips **305-310** based on the clips' association with a "Music" tag. Specifically, this figure illustrates how the media editing application of some embodiments compresses the audio signals of clips **305-310** as insert effects instead of routing the audio signals using the "send and return". As shown, the figure includes a set of compression modules **505**. In some embodiments, the set of compression modules **505** represents separate instances of the same compression module that are linked parametrically. For example, the output of these instances can be based on the same set of compression parameters or settings.

As shown in FIG. **5**, the audio signals of clips **305-310** are individually compressed by the set of compression modules **505**. The compressed audio signals of clips **305-310** are then output to the master **210**. As indicated by the "+" symbol, the compressed audio signals of the clips **305** and **310**, and the audio signal of clip **315** are then mixed. This mixed audio signal is received at the master **210** that defines the output audio signal for the composite presentation.

Referring back to FIG. **1**, process **100** determines (at **130**) whether any other clip is tagged with a different tag having an associated effect. When no other clip is tagged with a different tag, process **1500** proceeds to **1520**. Otherwise, the process outputs (at **155**) the composite presentation. For example, the media editing application may output the composite presentation by playing a real-time preview. Alternatively, the media editing application renders and/or mixes the composite presentation to storage (e.g., for playback at another time). The process then ends.

Some embodiments perform variations on process **100**. For instance, process **100** of some embodiments identifies each effect in an effect chain. Specifically, before identifying a next tag with an effect, process **100** applies each effect in the chain to a set of tagged clips. Also, some embodiments might take into account that a clip can be a compound clip (described below). In some such embodiments, process **100** identifies each outer metadata tag of the compound clip and each inner tag of the compound clip's nested clips. Process **100** then applies one or more effects to the compound clip and/or the inner clips according to this identification. Several examples applying effects to compound clips are described below by reference to FIGS. **6-10**.

In the examples described above, different effects are applied using different techniques. In some embodiments, the media editing application automatically determines whether to apply an effect by using an "insert" or by using the "send and return". For instance, the media editing application of some embodiments automatically applies a first type of effect (e.g., reverb, echo) using the "send and return", while applying a second type of effect (e.g., compressor, equalizer) as an "insert" effect. In conjunction with this automatic determination, or instead of it, the media editing application of some embodiments provides one or more user-selectable items for specifying whether to apply an effect as a "send" effect or an "insert" effect.

II. Applying Effects to Compound Clips

The media editing application of some embodiments allow users to create compound clips from multiple different clips. In some embodiments, a compound clip is any combination of clips (e.g., in a composite display area or in a clip browser as described below by reference to FIG. **22**) and nests clips within other clips. Compound clips, in some embodiments, contain video and audio clips as well as other compound clips. As such, each compound clip can be considered a mini project or a mini composite presentation, with its own distinct project settings. In some embodiments, compound clips function just like any other clips. That is, the application's user can add the compound clips to a project or composite display area, trim them, tag them, retime them, and add effects and transitions.

FIG. **6** illustrates an example of specifying an effect for a compound clip. Specifically, this figure illustrates (1) creating a compound clip from multiple different clips, (2) tagging the compound clip with a metadata tag, and (3) specifying an effect for the metadata tag. Five operational stages **605-625** of the GUI are shown in this figure.

As shown, the figure includes a composite display area **660** and a tag display area **665**. The composite display area **660** provides a visual representation of the composite presentation (or project) being created with the media editing application. Specifically, it displays one or more geometric shapes that represent one or more media clips that are part of the composite presentation. In some embodiments, the tag display area **665** displays one or more pieces of metadata associated with different media clips.

The first stage **605** shows the tag display area **665** and the composite display area **660**. The tag display area **665** includes a metadata tag **655** that is associated with an add effect control **660**. The composite display area **660** displays representations of three clips **630-640** that are not tagged with the metadata tag **655**. In this first stage, the user selects the clip **630** by selecting a corresponding representation in the composite display area **660**.

The second stage **610** shows the creation of a compound clip from clips **630** and **635**. Specifically, after selecting these two clips, the user selects a selectable option **640** (e.g., context menu item) to create the compound clip **650** as illustrated in the third stage **615**. In some embodiments, the media editing application provides several different controls (not shown) for creating the compound clip. Several examples of such controls include (1) a text field for inputting a name for the compound clip, (2) a first set of control for specifying video properties (e.g., automatically based on the properties of the first video clip, custom), and a second set of controls for specifying audio properties (e.g., default settings, custom).

The third stage **615** illustrates tagging the compound clip **650** with the first metadata tag **655**. Here, a tagging option **645** is used to tag the compound clip **650**. However, different embodiments provide different ways for tagging a compound clip. The fourth stage **620** illustrates the selection of an add effect control **660**. The selection causes an add effect window **665** with a list of effects to appear as illustrated in the fifth stage **625**. As shown in the fifth stage **625**, the add effect window **665** displays several different effects from which the user can choose from to associate with the first metadata tag **655**. The user then selects the reverb effect to associate it with the first metadata tag **655**.

Once the effect is set, the media editing application applies the reverb effect to the compound clip **650** in order to produce a resulting composite presentation. For example, the media editing application of some embodiments applies the reverb effects to the compound clip **650** to play a real-time preview of the presentation. Alternatively, the media editing application renders or outputs the sequence in the composite display area **660** to storage for playback at another time.

FIG. **7** shows a signal flow diagram **700** that conceptually illustrates the application of the reverb effect on the compound clip **650**, in some embodiments. Specifically, this figure illustrates an example of how audio signals of clips **630-640** (in the composite display area **660** of FIG. **6**) are routed to output a mixed audio signal with the reverb effect. As shown, the figure includes the clips **630-640**, the master **210**, and the reverb FX module **205**.

As shown in FIG. **7**, the audio signals of clips **630** and **635** are mixed for the compound clip **650**. The mixed audio signal of the compound clip **650** is sent to the reverb FX module **205**. The reverb FX module **205** processes the received audio signal and returns the audio signal containing the reverb effect to the master **210**. The master **210** receives a mixed audio signal containing the audio signal of the compound clip **650**, the audio signal of clip **640**, and the audio signal containing reverb effect. The master **210** then outputs a resulting mixed audio signal.

In the example illustrated in FIG. **7**, the "send" is performed on the audio signal of the compound clip **650**. Alternatively, the media editing application of some embodiments allows its users to add "insert" effects for compound clips tagged with a metadata tag. Several examples of such "insert" effects are described above by reference to FIG. **5**.

In the previous example, a compound clip is tagged with a metadata tag that is associated with an effect. Also, the nested clips of the compound clip are not tagged with this metadata tag. Accordingly, the effect associated with the compound clip's tag is applied to the audio signal of the compound clip. In some cases, one or more inner clips of the compound clip are tagged with a metadata tag. In order to simply the discussion below, a compound clip's tag will be referred to as an outer tag, while the tag of the inner clip of the compound clip will be referred to as an inner tag. Also, in several examples below, the outermost tag refers to the tag of the compound clip that is not contained by another compound clip.

FIG. **8** shows a signal flow diagram **800** that conceptually illustrates the application of the reverb effect on an inner clip **805** of a compound clip **820**. Specifically, this figure illustrates an example of how audio signals of clips **805**, **815**, and **810** (e.g., in the composite display area **660** of FIG. **6**) are routed to output a mixed audio signal with the reverb effect. In this example, the inner clip **805** has been tagged with a "Dialog" tag with a reverb effect, while the compound clip **820** is not tagged with any tag.

As shown, the audio signal of clip **805** is routed to the reverb FX module **205**. This is because the clip **805** is tagged with the "Dialog" tag that is associated with a reverb effect. In other words, even though the clip **805** is a nested clip of the compound clip **820**, the media editing application of some embodiments identifies each inner tag of the compound clip's nested clips to apply one or more effects. Here, the reverb FX module **205** applies the reverb effect to the received audio signal and returns an audio signal containing the reverb effect to the master **210**. As indicated by the "+" symbol, the audio signals of clip **805** and **810** are combined for the compound clip **820**. The audio signal of the compound clip **820**, the audio signal containing the reverb effect for clip **805**, and the audio signal of clip **805** are then mixed. The master **210** receives the mixed audio signal and outputs a resulting mixed audio signal.

In the example described above, the output of the reverb FX module **205** is sent to the master **210** instead of being mixed in as part of the compound clip **820**. This is because the media editing application of some embodiments defines a separate auxiliary ("aux") bus or virtual pathway for one or more effects associated with a metadata tag. In some embodiments, this aux bus always outputs to the master.

FIG. **9** shows a signal flow diagram **900** that conceptually illustrates how audio signals of several clips are routed to a particular aux bus based on the clips' association with a metadata tag. This example is similar to FIG. **8**. However, the "Dialog" tag is associated with a chain of effects that includes a reverb effect and an echo effect. Also, the clips **805** and **815** are both tagged with the "Dialog" tag.

As shown in FIG. **9**, the audio signal of each clip that is tagged with the "Dialog" tag is routed to the "Dialog" aux bus. Specifically, the audio signals of clips **805** and **815** are both routed to this aux bus. The audio signals are routed to the aux bus regardless of whether the clip is a nested clip (as in clip **805**) or a non-nested clip (as in clip **815**). The audio signals of clips **805** and **815** are then combined and sent over the aux bus in order to apply the chain of effects to the clips **805** and **805**.

In the example illustrated in FIG. **9**, the combined audio signal is first routed to the reverb FX module **205**. To continue the chain of effects, the audio signal containing the reverb effect is received at the echo FX module **305**. The echo FX module **305** processes the incoming audio signal and outputs a processed audio signal. The output of the echo FX module **305** is returned to the master **210**. As indicated by the "+" symbol, the audio signals of clip **805** and **810** are combined for the compound clip **820**. The audio signal of the compound clip **820**, the audio signal from the echo FX module **305**, and the audio signal of clip **805** are then mixed. The master **210** receives the mixed audio signal and outputs a resulting mixed audio signal.

In some cases, a compound clip is tagged with the same tag as one or more of the compound clip's inner clips. In some embodiments, the media editing application identifies an appropriate level of a compound clip to apply the effect such that the effect is not reapplied at another level. For example, when the inner clip's tag is the same as the compound clip's outer tag, the media editing application of some embodiments identifies the compound clip's outer tag and performs the editing operations based on the compound clip's outer tag. This prevents the same effect being applied to the compound and one or more of the compound clip's nested clips.

FIG. **10** conceptually illustrates a process **1000** that some embodiments use to apply one or more effects to a compound clip and/or the compound clip's nested clips. In some embodiments, process **1000** is performed by a media editing application. Process **1000** may be a performed in conjunction with several other processes (e.g., including FIGS. **15**, **16**, and **20** described below). Process **1000** will be described by reference to FIG. **11** that illustrates applying an effect to a compound clip based on the compound clip's outer tag.

As shown, process **1000** identifies (at **1005**) a clip tagged with a particular metadata tag in a composite presentation. Process **1000** then determines (at **1010**) whether the clip tagged the particular metadata tag is a compound clip. In the example illustrated in FIG. **11**, the clip **820** is a compound clip tagged with a particular metadata tag. Specifically, the compound clip **820** is associated with a "Dialog" tag having a reverb effect.

When the clip is not a compound clip, process **1000** proceeds to **1035**, which is described below. Otherwise, process **1000** identifies (at **1015**) the particular metadata tag of the compound clip and each inner tag of the compound clip's nested clips. Process **1000** then determines (at **1020**) whether any inner tag of the compound clip's nested clips is different from the outer tag of the compound clip.

When no inner tag is different than the outer tag or no nested clip is tagged with a tag associated with an effect, process **1000** performs (at **1025**) one or more operations based on the outer tag. In the example illustrated in FIG. **11**, as the compound clip's outer tag takes precedence over the inner tag, the effect associated with the inner tag of inner clip **805** is not applied to this inner clip. Instead, the effect is applied to the mixed audio signal of the compound clip **820**. Specifically, the audio signals of clips **810** and **805** are mixed as a mixed audio signal for the compound clip **820**. As the compound clip is tagged with the "Dialog" tag, the mixed audio signal of the compound clip is then sent to the reverb FX module **205**. Although the clip **805** is also tagged with the "Dialog" tag, the clip's audio signal is not sent to the reverb FX module. This is because the media editing application identified that the compound clip's outer tag is the same as the inner tag of the nested clip **805**.

The reverb FX module **205** applies the reverb effect to the received audio signal and returns an audio signal containing the reverb effect to the master **210**. The mixed audio signal of the compound clip **820**, the audio signal containing the reverb effect from the reverb FX module **205**, and the audio signal of clip **815** are then mixed. The master **210** then receives the mixed audio signal and outputs a resulting audio signal.

Referring back to FIG. **10**, when one or more inner tags of the compound clip's nested clips are different, process **1000** performs (at **1030**) one or more operations based on each different inner tag. Process **1000** also performs (at **1030**) one or more operations based on the compound clip's outer tag. In some embodiments, process **1000** applies the different effects following a sequence of operations (e.g., as represented in a signal chain or render graph). For example, when a reverb effect is associated with a first metadata tag of a compound clip's nested clip, process **1000** of some embodiments first applies the reverb effect to the compound clip's nested clip. Once the effect is applied to the nested clip, process **1000** combines the nested clip with one or more other clips in order to apply a second effect associated with a second metadata tag of the compound clip.

Process **1000** then determines (at **1035**) whether there is any other tagged clip in the composite presentation. When there is another tagged clip, process **1000** returns to **1005** which was described above. Otherwise, process **1000** ends.

Some embodiments perform variations on process **1000**. For example, the specific operations of process **1000** may not be performed in the exact order shown and described. The specific operations may not be performed in one continuous series of operations, and different specific operations may be performed in different embodiments.

III. Audio Meters

In many of the example described above, the audio signals of several clips are mixed and output as one combined audio signal for a composite presentation. In some cases, the mixed audio signal of a compound clip is again combined with an audio signal of another clip to output a composite presentation. In some embodiments, the media editing application displays the audio level of a set of one or more clips even though the set of clips has been mixed with other clips.

A. Displaying Audio Levels

FIG. **12** illustrates an example of displaying the audio levels of several mixed clips. Specifically, this figure illustrates meters that indicate the audio levels of the clips even though the clips have been mixed with other clips. Three operational stages **1205-1215** are shown in this figure. The composite display area **660** is the same as the one described above by reference to FIG. **6**. The figure also includes an audio mixer **1220**.

In some embodiments, the media editing application provides audio meters and/or audio controls for metadata tags associated with different clips. An example of this is illustrated in FIG. **12**. Specifically, the audio mixer **1220** includes a corresponding audio meter (**1245** or **1255**) and a level control (**1240** or **1250**) for each of a first metadata tag specified as "Dialog" and a second metadata tag specified as "SFX". Several other examples of providing different controls (e.g., audio meters, audio controls) for different metadata tags are described below by reference to FIG. **16**.

The first stage **1205** shows the composite display area **660** and the audio mixer **1220** prior to playing the composite presentation. As shown, clip **1225** is tagged with the "Dialog" tag. Compound clip **1235** includes several nested clips **1260** and **1265**. The compound clip **1235** is tagged with the "SFX" tag. The nested clips **1260** and **1265**, and clip **1230** are not tagged with the "Dialog" tag or the "SFX" tag.

The second stage **1210** shows the playback of the composite presentation represented in the composite display area **660** at a first instance in time. To output the composite presentation's mixed audio signal, the audio signals of the nested clips **1260** and **1265** has been mixed for the compound clip **1235**. In addition, the audio signals of the clips **1225** and **1230** have been mixed with the audio signal of the compound clip **1235**. In this second stage **1210**, the audio meter **1245** displays the audio level of the clip **1225** even though the clips in the composite display area **660** has been mixed to play the composite presentation.

The third stage **1215** shows the playback of the composite presentation at a second instance in time. Similar to the previous stage, the audio meter **1255** displays the audio level of the compound clip **1225** even though the compound clip has been mixed with the clips **1225** and **1230**.

B. Sending an Audio Signal Over a Meter Bus

In the example illustrated in FIG. **12**, the media editing application provides meters that indicate the audio levels of clips that have been mixed with other clips. To display audio levels of these clips, the media editing application of some embodiments creates one or more meter buses and routes audio signals of the clips over the meter buses.

FIG. **13** shows a signal flow diagram **1300** that conceptually illustrates sending an audio signal of a clip over a meter bus **1305** in order to display the clip's audio level during playback of a mixed audio signal of a composite presentation. As shown, the figure includes clips **1310** and **1315** that are mixed as a compound clip **1320**. The figure also includes the meter bus **1305** and the master **210**. The master **210** is the same as the one described above by reference to FIG. **2**.

As shown FIG. **13**, the signal flow **1300** includes a chain or a sequence of operations that is performed on the clips **1310** and **1315**. However, this signal chain does not include a place to determine the audio level of clip **1310** once it has been summed with clip **1315**. Specifically, in the signal chain, the clips **1310** and **1315** are mixed as the compound clip **1320**. The mixed audio signal of clips **1310** and **1315** is then output through the master **210**. Also, the mixed audio signal cannot be used to determine how much the clip **1310** contributed to the overall mix.

As the audio level of clip **1310** cannot be determined using the mixed audio signal, the clip's audio signal is sent over the meter bus **1305**. This meter bus **1305** is not for playing sound but for metering. Specifically, in the example illustrate in FIG. **13**, the meter bus **1305** is for displaying the audio level of each clip tagged with the "Dialog" tag. In some embodiments, the clips audio is routed over the meter bus **1305** to a component (not shown) that translates the audio signal to one or more meters. For example, the media editing application of some embodiments determines a set of decibel (dB) values. The set of dB values is then used to meter the audio level of the clip **1310**.

FIG. **14** shows a signal flow diagram **1400** that conceptually illustrates routing a combined audio signal of several clips over the meter bus **1305** for the purposes of displaying the clips' audio level. This example is similar to FIG. **13**. However, in addition to the clip **1310**, the figure includes a clip **1405** that is tagged with the "Dialog" tag.

As shown in FIG. **13**, the clips **1310** and **1315** are mixed as the compound clip **1320**. The mixed audio signal of the clips **1310** and **1315** is then combined with the audio signal of the clip **1405**. The composite audio signal of the clips **1310**, Q**15**, and Q**15** is then output through the master **210**. To display the audio level of the "Dialog" clips **1310** and **1410**, the audio signals of these clips are combined and sent over the meter bus **1305**. Similar to the example of FIG. **14**, the combined audio signal is then translated into a set of decibel values by the media editing application.

In some embodiments, the media editing application takes into account other factors when displaying the audio level of clips that has been with other clips. The media editing application of some embodiments scales (i.e., reduces or increases) the audio level of one or more clips by processing later down the signal chain. For example, in the example illustrated in FIG. **14**, the audio meter for the "Dialog" clips **1310** and **1405** should reflect the audio level of the entire mix (e.g., as defined by the master **210**). That is, when the master's volume is set at a particular dB, the combined audio signal of clips **1310** and **1405** should be scaled or synchronized such that audio meter does not indicate an audio level that is higher than the particular dB.

C. Estimating the Volume

In the previous example, a combined audio signal of several clips is sent over a meter bus to display the audio level of several clips. Alternatively, the media editing application of some embodiments estimates the audio level of the one or more clips. That is, instead of routing the audio signal over the meter bus, the media editing application numerically estimates the audio level by extracting metering information from the clips prior to mixing the clips.

FIG. **15** conceptually illustrates a process **1500** that some embodiments use to estimate audio levels of clips that are tagged with metadata tags. In some embodiments, process **1500** is performed by a media editing application. As shown, process **1500** identifies (at **1505**) each clip, in a composite presentation, that is tagged with a particular metadata tag. Process **1500** then extracts (at **1510**) metering information (e.g., audio level) from each clip tagged with the particular metadata tag.

Process **1500** then determines (at **1515**) whether any other clip is tagged with a different tag. When no other clip is tagged with a different tag, process **1500** proceeds to **1520**. Otherwise, process **1500** returns to **1505** which was described above.

At **1520**, process **1500** determines the audio level of one or more clips based on the metering information. In the example described above in FIG. **14**, the audio level of several clips is determined by summing the clips' audio signals and sending the summed audio signal over the meter bus. Here, as the audio signals are being mixed later in the signal chain, process **1500** estimates the audio level based on the metering information (e.g., audio signal data) extracted from each of the clips. In other words, process **1500** estimates what the audio level would be when two or more audio signals of different clips are added together.

In some embodiments, process **1500** estimates the audio level by adding the power contribution of each clip. One example of such addition is adding about 3 dB for every doubling of equal input sources. For example, if the audio signals of two clips have an identical volume of −10 dB, then the sum of the two signals is estimated to be about 3 dB higher. As such, the estimated sum of the two signals is about −7 dB. If there are four audio signals that have the identical volume, then the sum of these signals will be estimated to be about 6 dB higher, and so on. One example formula for adding sound pressure levels of multiple sound sources is shown below:

$$L_\Sigma = 10 \cdot \log_{10}\left(10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}} + \ldots + 10^{\frac{L_n}{10}}\right)\text{dB}$$

Here, L_Σ equals total level, and $L_1, L_2, \ldots L_n$ equal sound pressure level (spl) of the separate sources in dBspl. This formula above translates to about 3 dB per doubling of equal sources. One of ordinary skill in the art would realize that other formulas can be used to differently sum two or more audio signals in order to estimate the audio level.

Returning to FIG. **15**, process **1500** displays (at **1525**) the audio level of one or more tagged clips based on each estimated audio level. Specifically, process **1500** displays the audio level when playing the mixed audio signal of the composite presentation. Process **1500** then ends.

In some embodiments, process **1500** takes into account other factors when displaying the audio level of clips that has been previously mixed. For example, process **1500** of some embodiments scales (i.e., reduces or increases) the audio level of one or more clips by processing later down the signal chain. In some embodiments, the process estimates the audio level of the mixed clips by identifying what each clip is contributing to the overall mix and numerically estimating the audio level based on the identification and the extracted metering information. For example, when a compound clip is muted, the media editing application should not display audio level of the compound's nested clip as the nested clip is also muted.

In some cases, estimating the audio level has several advantages over routing audio signals over meter buses. For example, this technique can be less computationally expensive than using meter buses. This is because the meter buses do not have to be created and the audio signals of different clips do not have to be routed over these meter buses.

IV. Parameter Controls and Propagation

The media editing application of some embodiments uses metadata to provide user interface controls. In some embodiments, these controls are used to display properties of tagged clips and/or specify parameters that affect the tagged clips. Example of such user interface controls include audio meters, volume controls, different controls for modifying images (e.g., distorting, blurring, changing color), etc.

FIG. **16** conceptually illustrates a process **1600** that some embodiments use to construct user interface controls based on metadata tags. In some embodiments, process **1600** is performed by a media editing application. As shown, process **1600** identifies (at **1605**) each clip tagged with a particular metadata tag. In some embodiments, one or more clips are categorized with a particular role or category. For example, several clips may be assigned one audio role of "Dialog", "Music", or "SFX". Process **1600** then provides one or more user interface controls. Here, the user interface controls are also associated with the tagged clips. That is, the user interface controls are associated so that these controls can be used to display or modify properties of the tagged clips.

Process **1600** then determines (at **1615**) whether any other clip is tagged with a different tag. When no other clip is tagged with a different tag, process **1600** proceeds to **1620**. Otherwise, process **1600** returns to **1605** which was described above. Process **1600** then receives (at **1620**) adjustment of parameters through one or more corresponding user interface controls. Process **1600** then outputs (at **1625**) the sequence of clips in the composite presentation by propagating the adjusted parameter to one or more of corresponding tagged clips. Process **1600** then ends.

Some embodiments allow a compound clip to be tagged with the same tag as one or more of the compound clip's inner clips. In some embodiments, the media editing application identifies an appropriate level in a render graph or signal chain to adjust parameters such that the parameters are not readjusted at another level. For example, when the inner clip's tag is the same as the compound clip's outer tag, the media editing application of some embodiments identifies the compound clip's outer tag and performs the adjustment based on the compound clip's outer tag. This prevents the same adjustment being applied at multiple different levels.

FIG. **17** shows a data flow diagram **1700** that conceptually illustrates an example of adjusting parameters of several clips at different levels of a hierarchy, in some embodiments. As shown in FIG. **17**, clips **1705** and **1710** are combined for the compound clip **1715**. The nested clips **1705** and **1710** are tagged with the "Dialog" tag, while the compound clip **1715** is not tagged with this tag. As the compound clip **1715** is not tagged with the same tag as its nested clips **1705** and **1710**, the parameter adjustment occurs for this compound clip at the level of the nested clips. Similarly, the adjustment for compound clip **1740** occurs at the level of the nested clips **1735** and **1730**.

In the example illustrated in FIG. **17**, the clips **1720** and **1725** are combined for the compound clip **1730**. Here, the nested clip **1720** and the compound clip **1730** are tagged with the "Dialog" tag, while the nested clip **1725** is not tagged this tag. As the compound clip **1730** includes the same tag as one of its nested clips (i.e., the clip **1720**), the adjustment occurs for this compound clip at the level of the compound clip. Similarly, the adjustment for compound clip **1755** occurs at the level of the compound clip. This is because the nested clips **1745** and **1755** are tagged with the same "Dialog" tag as the compound clip **1755**.

In some cases, the compound clip's outer tag can be different from one or more tags of its inner clips. When the compound clip's outer tag is different from the inner clip's tag, the media editing of some embodiments adjusts one set of parameter associated with the inner clip based on the inner clip's tag. Also, the media editing application adjusts another set of parameters associated with the compound clip based on the compound clip's tag.

In some embodiments, the media editing application does not support tagging compound clips. In some such embodiments, the adjustment is only made at the nested clip level. For example, when several nested clips of a compound clip are tagged with a "Dialog" tag, an adjustment to a control relating to the "Dialog" tag will adjust parameters associated with these nested clips and not the combined clip of the compound clip.

V. Outputting Content to Different Tracks

The media editing application of some embodiments allows a composite presentation to be output to different tracks (e.g., different files) based on metadata associated with media content. Outputting content to different tracks is particularly useful because one track can easily be replaced with another track. For example, when audio content is mixed, a movie studio cannot replace a dialog track in one language with another dialog track in another language. With audio content output to different tracks (e.g., audio files), the movie studio can easily replace one dialog track with another such that the dialog is in a different language.

A. Specifying Output Tracks

FIG. **18** illustrates specifying output tracks for clips based on metadata that is associated the clips. Six operational stages **1805-1830** of the GUI are shown in this figure. In this example, the tag display area **665** includes an output control (**1835**, **1840**, or **1845**) for each metadata tag (**1850**, **1855**, or **1860**). The output control allows the application's user to specify an output track or stem for each clip associated with a metadata tag.

The first stage **1805** shows the tag display area **665** and the composite display area **660**. The tag display area **665** includes a list of metadata tags. This list includes a first metadata tag **1850** specified as "Dialog", a second metadata tag **1855** specified as "Music", and a third metadata tag **1860** specified as "SFX". The first metadata tag **1850** is associated with a first output control **1835**, the second metadata tag **1855** with a second output control **1840**, and the third metadata tag **1860** with a third output control **1845**.

The composite display area **660** displays representations of five clips **1865-1885**. The clips **1865** and **1885** are tagged with the first metadata tag **1850**, the clip **1870** is tagged with the second metadata tag **1855**, and the clips **1875** and **1880** are tagged with the third metadata tag **1860**. To specify an output track for the clips **1865** and **1885** that are tagged with the first metadata tag **1850**, the user selects the output control **1835**. The selection causes a track control **1890** to appear as illustrated in the second stage **1810**.

The second stage **1810** illustrates specifying an output track for the clips **1865** and **1885** tagged with the first metadata tag **1850**. Specifically, the user specifies the output track to be "Track **1**" by using the track control **1890**. In some embodiments, the media editing application provides various different options for outputting content. Several example output options include compression type and settings, bit rate, bit size, mono or stereo, name of file, etc. For instance, when outputting an audio containing dialog to a separate file, the media editing application of some embodiments displays different user interface items that allow the application's user to define the output audio clip such as the type of audio file, compression settings, etc.

The third and fourth stages **1815** and **1820** illustrate specifying an output track for the clip **1870** that is tagged with the second metadata tag **1855**. To specify the output track, the user selects the output control **1840** that is associated with the second metadata tag **1855**. The selection causes the track control **1890** to appear, as illustrated in the fourth stage **1820**. In the fourth stage **1820**, the application's user specifies the output track to be "Track **2**" by using the track control **1890**.

The fifth and sixth stages **1825** and **1830** are similar to the previous stages. However, in these stages **1825** and **1830**, an output track is specified for the clips **1875** and **1880** that are tagged with the third metadata tag **1860**. To specify the output track, the user selects the output control **1845** that is associated with the third metadata tag **1860**. The selection causes the track control **1890** to appear, as illustrated in the sixth stage **1830**. In the sixth stage **1830**, the user specifies the output track to be "Track **3**" by using the track control **1890**. Once the output tracks are specified for the metadata tags, the user can select an output or export option (not shown) to start the output of clips based on the clip's association with a particular metadata tag.

In the example described above, several output tracks are associated with metadata tags. In some embodiments, the media editing application allows a user to associate metadata tags with output tracks. FIG. **19** provides an illustrative example of an output tool **1900** for the media editing application. As shown, the figure includes several user-selectable items (e.g., drop-down lists) **1905-1920**. Each selectable item represents a particular output track for a composite presentation. The user can use any one of these items **1905-1920** to associate one or more roles with a particular track. For instance, two different roles have been specified with the selectable item **1920**. This is different from FIG. **18** where a particular output track is associated with one particular metadata tag (e.g., a role).

As shown in FIG. **19**, several of these selectable items **1905-1920** are associated with other user interface items **1925-1935**. A user of the application select any one of these items **1925-1935** to associate a particular output setting (e.g., mono, stereo, surround) with a corresponding output track. The user can then select a button **1940** to specify a multi-track output for the composite presentation.

B. Performing Multiple Passes

In some embodiments, the media editing application performs multiples passes on a render graph or signal chain to output a composite presentation to different tracks. FIG. **20**A shows a signal flow diagram **2000** that conceptually illustrates the problem of outputting the composite presentation to different tracks in a single pass. To simplify the discussion, this signal flow diagram **2000** represents a scenario where only one compound clip **2010** that nests clips **2005** and **2010** is in the composite presentation.

As shown in FIG. **20**A, the inner clip **2005** is tagged with a first metadata tag, and inner clip **2010** is tagged with a second metadata tag. The output track for the first metadata tag has been specified as "Track **1**", and the output track for the second metadata tag has been specified as "Track **2**". Here, the audio signals of clips **2005** and **2010** are mixed as one mixed audio signal for the compound clip **2010**. This prevents the audio signal of clip **2005** to be played through one channel, while the audio signal of clip **2010** is being played through another channel. As such, the mixed audio signal cannot be unmixed to output the audio signal of clip **2005** to the first track and the audio signal of clip **2010** to the second track.

Although the composite presentation cannot be unmixed during playback, the media editing application allows the composite presentation to be output to different audio files by performing multiple passes on a render graph or signal chain. FIG. **20**B illustrates outputting the composite presentation different audio files. Two example stages **20**B**05** and **20**B**10** of the media editing application are illustrated in this figure. Specifically, these stages illustrate performing multiple rendering passes to output the composite presentation to different files.

The first stage **20**B**05** illustrates a first pass that is performed to output the audio content of clip **2005** to "Track **1**". The audio signals of clips **2005** and **2010** are mixed for the compound clip **2020**. However, in this first pass, the audio signal of clip **2010** is disabled (e.g., muted or silenced). As the audio clip **2010** is muted, the mixed audio signal includes only the audio signal of the clip **2005**.

The second stage **20**B**10** illustrates a second pass that is performed to output the audio content of clip **2010** to "Track **2**". Similar to the first stage **20**B**05**, the audio signals of clips **2005** and **2010** are mixed for the compound clip **2020**. However, in this second pass, the audio signal of clip **2005** is disabled (e.g., muted). As the audio clip **2005** is disabled, the mixed audio signal includes only the audio signal of the clip **2010**. In some embodiment, the output files include a same duration as the composite presentation. For example, if the duration of the composite presentation (e.g., represented in the composite display area) is one hour and each of the clips **2005** and **2010** includes thirty minutes of sound, then each output file will be one hour in duration with thirty minutes of sound.

In the example described above, multiple rendering passes are performed to output the audio content to different tracks. The media editing application of some embodiments performs these multiple passes simultaneously. In some such embodiments, the media editing application generates multiple copies of one or more render objects (e.g., render graphs, render files) for rendering the sequence of clips in the composite display area. The media editing application then performs the multiple passes such that these passes occur at least partially at the same time. By simultaneous performing these passes, the media editing application saves time in that it does not need to wait for one pass to end to start another. This also saves time as files (e.g., source clips) are read out of disk or loaded in memory once instead of multiple times.

The preceding section described and illustrated various ways to use metadata to facilitate output operations. FIG. **21** conceptually illustrates a process **2100** that some embodiments use to output a composite presentation to different tracks. In some embodiments, process **2100** is performed by a media editing application. As shown, process **2100** receives (at **2105**) input to output a composite presentation (e.g., a sequence of clips in the composite display area). Process **2100** then identifies (at **2110**) a track to process.

At **2115**, process **2100** identifies each clip tagged with a tag (e.g., role) that is associated with the identified track. An example of associating one or more roles to a particular output track is described above by reference to FIG. **19**.

Process **2100** then adds (at **2120**) each identified clip to a render list for that track. Process **2100** then determines (at **2125**) whether there are any more tracks. When there is another track, process **2100** returns to **2110** that was described above. Otherwise, process **2100** renders the composite presentation based on one or more render lists. For example, process **2100** of some embodiments renders the composite presentation by identifying clips in a render list, combining any two or more clips in the list, and outputting the combined clip to a particular track. Process **2100** then ends.

Some embodiments perform variations on process **2100**. For example, the operations of process **2100** might be performed by two or more separate processes. Also, the specific operations of the process may not be performed in the exact order shown and described.

VI. Software Architecture

A. Example Media Editing Application

Having described several example editing operations above, an example media editing application that implements several editing features will now be described. FIG. **22** illustrates a graphical user interface (GUI) **2200** of a media editing application of some embodiments. One of ordinary skill will recognize that the GUI **2200** is only one of many possible GUIs for such a media editing application. In fact, the GUI **2200** includes several display areas which may be adjusted in size, opened or closed, replaced with other display areas, etc. As shown, the GUI **2200** includes a clip library **2205** (also referred to as an event library), a clip browser **2210** (also referred to as a clip browser), a composite display area **2215**, a preview display area **2220**, an inspector display area **2225**, and a toolbar **2235**.

The clip library **2205** includes a set of folder-like or bin-line representations through which a user accesses media clips that have been imported into the media editing application. Some embodiments organize the media clips according to the device (e.g., physical storage device such as an internal or external hard drive, virtual storage device such as a hard drive partition, etc.) on which the media represented by the clips are stored. Some embodiments also enable the user to organize the media clips based on the date the media represented by the clips was created (e.g., recorded by a camera).

Within the clip library **2205**, users can group the media clips into "events" or organized folders of media clips. For instance, a user might give the events descriptive names that indicate what kind of media is stored in the event (e.g., the "New Event 2-5-11" event shown in clip library **2205** might be renamed "European Vacation" as a descriptor of the content). In some embodiments, the media files corresponding to these clips are stored in a file storage structure that mirrors the folders shown in the clip library.

In some embodiments, the clip library **2205** enables users to perform various clip management actions. These clip management actions include moving clips between bins (e.g., events), creating new bins, merging two bins together, duplicating bins (which, in some embodiments, create a duplicate copy of the media to which the clips in the bin correspond), deleting bin, etc.

As shown in FIG. **22**, the clip library **2205** displays several keywords **2202** and **2204**. To categorize a clip or associate the clip with a particular keyword, the application's user can drag and drop the clip onto the particular keyword. The same technique used in some embodiments to associate multiple clips with the particular keyword by simultaneously dragging and dropping the clips onto the keyword. In some embodiments, the keywords **2202** and **2204** are represented as keyword collections (e.g., keyword bin or keyword folder) in the clip library **2205**. That is, the keyword collection acts a virtual bin or virtual folder that the user can drag and drop items onto in order to create keyword associations. In some embodiments, upon selection of a keyword collection, the media editing application filters the clip browser **2210** to only display those clips associated with a particular keyword of the keyword collection.

The clip browser **2210** allows the user to view clips from a selected folder or collection (e.g., an event, a sub-folder, etc.) of the clip library **2205**. In the example illustrated in FIG. **22**, the collection "New Event 2-5-11" is selected in the clip library **2205**, and the clips belonging to that folder are displayed in the clip browser **2210**. Some embodiments display the clips as thumbnail filmstrips (i.e., filmstrip representations). These thumbnail filmstrips are similar to the representations in the composite display area **2215**.

By moving a position indicator (e.g., through a cursor, through the application's user touching a touch screen) over one of the thumbnails, the user can skim through the clip. For example, when the user places the position indicator at a particular horizontal location within the thumbnail filmstrip, the media editing application associates that horizontal location with a time in the associated media file, and displays the image from the media file for that time. In addition, the user can command the application to play back the media file in the thumbnail filmstrip. In some embodiments, the selection and movement is received through a user selection input such as input received from a cursor controller (e.g., a mouse, touchpad, trackpad, etc.), from a touchscreen (e.g., a user touching a user interface (UI) item on a touchscreen), from the keyboard, etc. In some embodiments, one example of such a user selection input is the position indicator that indicates the user's interaction (e.g., with the cursor, the touchscreen, etc.). The term user selection input is used throughout this specification to refer to at least one of the preceding ways of making a selection, moving a control, or pressing a button through a user interface.

In the example illustrated in FIG. **22**, the thumbnails for the clips in the clip browser **2210** display an audio waveform underneath the clip that represents the audio of the media file. In some embodiments, as a user skims through or plays back the thumbnail filmstrip, the audio portion plays as well. Many of the features of the clip browser are user-modifiable. For instance, the user can modify one or more of the thumbnail size, the percentage of the thumbnail occupied by the audio waveform, whether audio plays back when the user skims through the media files, etc. In addition, some embodiments enable the user to view the clips in the clip browser **2210** in a list view. In this view, the clips are presented as a list (e.g., with clip name, duration, metadata, etc.). Some embodiments also display a selected clip from the list in a filmstrip view at the top of the clip browser **2210** so that the user can skim through or playback the selected clip. The clip browser in some embodiments allows users to select different ranges of a media clip and/or navigate to different sections of the media clip.

In some embodiments, the media editing application displays content differently based on their association with one or more metadata tags (e.g., keywords). This allows users to quickly assess a large group of media clips and see which ones are associated or not associated with any metadata tags. For example, in FIG. **22**, a horizontal bar is displayed across each of the clips **2240**-**2250**. This indicates to the application's user that these clips are tagged with one or more metadata tags.

In some embodiments, the media editing application allows the user to tag a portion of a clip with a metadata tag. To associate a metadata tag with a portion of a clip, the user can select the portion of the clip (e.g., using a range selector on a clip's filmstrip representation in the clip browser **2210**), and drag and drop the selected portion onto the metadata tag (e.g., **2202** or **2204**). For example, a user can specify that an audio clip includes crowd noise starting at one point in time and ending at another point, and then tag that range as "crowd noise". When a portion of a clip is associated with a metadata tag, the media editing application of some embodiments indicates this by marking a portion of the clip's representation in the clip browser **2210**. For example, a horizontal bar is displayed across only the portion the clip's filmstrip representation associated with a particular metadata tag, in some embodiments.

The composite display area **2215** provides a visual representation of a composite presentation (or project) being created by the user of the media editing application. As mentioned above, the composite display area **2215** displays one or more geometric shapes that represent one or more media clips that are part of the composite presentation. In some embodiments, the composite display area **2215** spans a displayed timeline **2226** which displays time (e.g., the elapsed time of clips displayed on the composite display area). The composite display area **2215** of some embodiments includes a primary lane **2216** (also called a "spine", "primary compositing lane", or "central compositing lane") as well as one or more secondary lanes (also called "anchor lanes"). The spine represents a primary sequence of media which, in some embodiments, does not have any gaps. The clips in the anchor lanes are anchored to a particular position along the spine (or along a different anchor lane). Anchor lanes (e.g., the anchor lane **2218**) may be used for compositing (e.g., removing portions of one video and showing a different video in those portions), B-roll cuts (i.e., cutting away from the primary video to a different video whose clip is in the anchor lane), audio clips, or other composite presentation techniques.

The user can select different media clips from the clip browser **2210**, and drag and drop them into the composite display area **2215** in order to add the clips to a composite presentation represented in the composite display area **2215**. Alternatively, the user can select the different media clips and select a shortcut key, a tool bar button, or a menu item to add them to the composite display area **2215**. Within the composite display area **2215**, the user can perform further edits to the media clips (e.g., move the clips around, split the clips, trim the clips, apply effects to the clips, etc.). The length (i.e., horizontal expanse) of a clip in the composite display area is a function of the length of the media represented by the clip. As the timeline **2226** is broken into increments of time, a media clip occupies a particular length of time in the composite display area. As shown, in some embodiments, the clips within the composite display area are shown as a series of images or filmstrip representations. The number of images displayed for a clip varies depending on the length of the clip (e.g., in relation to the timeline **2226**), as well as the size of the clips (as the aspect ratio of each image will stay constant). As with the clips in the clip browser, the user can skim through the composite presentation or play back the composite presentation. In some embodiments, the playback (or skimming) is not shown in the composite display area's clips, but rather in the preview display area **2220**.

The preview display area **2220** (also referred to as a "viewer") displays images from media files which the user is skimming through, playing back, or editing. These images may be from a composite presentation in the composite display area **2215** or from a media clip in the clip browser **2210**. In the example of FIG. **22**, the user is playing the composite presentation in the composite display area **2215**. Hence, an image from the start of the composite presentation is displayed in the preview display area **2220**. As shown, some embodiments will display the images as large as possible within the display area while maintaining the aspect ratio of the image.

The inspector display area **2225** displays detailed properties about a selected item and allows a user to modify some or all of these properties. The selected item might be a clip, a composite presentation, an effect, etc. As shown in FIG. **22**, the inspector display area **2225** displays information about the audio clip **2250**. To display the information, the application's user might have selected the audio clip **2250** from the clip browser **2210**. In this case, the information about the selected media clip **2250** includes name, notes, codec, audio channel count, and sample rate. However, depending on the type of media clip, the inspector display area **2225** can display other information such as file format, file location, frame rate, date created, etc. In some embodiments, the inspector display area **2225** displays different metadata tags associated with a clip. For example, the inspector display area **2225** includes a text box **2206** for displaying and/or modifying one or more metadata tags.

The toolbar **2235** includes various selectable items for editing, modifying items that are displayed in one or more display areas, etc. The illustrated toolbar **2235** includes items for video effects, visual transitions between media clips, photos, titles, generators and backgrounds, etc. The toolbar **2235** also includes selectable items for media management and editing. Selectable items are provided for adding clips from the clip browser **2210** to the composite display area **2215**. In some embodiments, different selectable items may be used to add a clip to the end of the spine, add a clip at a selected point in the spine (e.g., at the location of a playhead), add an anchored clip at the selected point, perform various trim operations on the media clips in the composite display area, etc. The media management tools of some embodiments allow a user to mark selected clips as favorites, among other options.

The audio mixer **2255** provides different audio mixing tools that the application's user can use to define the output audio of the composite presentation represented in the composite display area **2215**. The audio mixer **2255** includes several level controls (**2260**, **2270**, and **2280**) and several audio meters (**2265**, **2275**, and **2285**). The level control **2280** and the audio meters **2285** are related to the master that represents the output audio. Specifically, the master's level control **2280** raises or lowers the combined output level of all sequence of clips in the composite display area at the same time. That is, the control **2280** affects output levels during playback, export to a file, etc. Hence, the level control **2280** adjusts the level of the output audio, and the meters **2285** display that audio level. In the example illustrated in FIG. **22**, the audio meters **2285** include a first meter that represents the left channel of the output audio, and a second meter that represents the right channel of the output audio. In some embodiments, the master includes an audio meter for each output track (e.g., channel, file) specified for the sequence. For example, when the sequence of the clips has four output tracks, there are four corresponding audio meters for the master in the audio mixer **2255**. Several examples of specifying different output tracks by using metadata tags are described above in Section V.

As shown in FIG. **22**, the audio meters **2285** provide visual representations of the level of the output audio. Specifically, each meter displays a fluctuating or moving bar in accord with the audio level. In some embodiments, the fluctuating bar changes color when the audio level exceeds a particular threshold. For example, the color of the bar may change from one color to another color when the volume goes over a predetermined threshold decibel value.

The level control **2260** and the audio meter **2265** are related to the keyword **2202**. The level control **2270** and the audio meter are related to the keyword **2204**. In some embodiments, the audio meters **2265** and **2275** display the audio levels of the clips associated with the corresponding keywords. For example, when a clip tagged with "Dialog" is being output, the audio meter **2265** fluctuates to indicate the level of the clip's audio. Similarly, the audio level control **2260** controls the audio level of each clip that is tagged with the keyword **2202**, and the audio level control **2270** controls the audio level of each clip tagged with the keyword **2204**.

As shown in FIG. **22**, the level controls **2260**, **2270**, and **2280** are represented as channel faders, while the audio meters **2265**, **2275**, and **2285** are represented as fluctuating bars. Alternatively, the media editing application of some embodiments provides different types of controls. For example, any one of the level controls can be provided as a dial knob that is rotated to adjust the gain or volume of each clip that is tagged with a particular keyword. Also, in different embodiments, the audio levels at different instances in time are represented as a graph, numerically by displaying different decibels, etc. In some embodiment, the audio controls (e.g., audio level controls **2260** and **2270**) are not used to control absolute audio levels but are used to make relative adjustments. In some such embodiments, the media editing application provides a wheel or a knob that can be turned infinitely to add or subtract gain to all clips tagged with a particular metadata tag.

In the example illustrated in FIG. **22**, the audio mixer **2255** includes other controls associated with the master and the keywords **2202** and **2204**. For example, the keyword **2204** includes (1) a mute button **2208** for muting all clips associated with the keyword, (2) a solo button **2212** for muting all other clips except those associated with the keyword, and (3) a pan control **2214** for controlling the spread of audio. The same set of controls is provided for the keyword **2202**. In addition, the master includes a mute button **2222** for muting all channels and a downmix button **2224** for mixing down all output channels to a single stereo output. In some embodiments, when the downmix is activated, all audio outputs in the composite display area's sequence are mixed down to stereo during playback, export to one or more files, etc. Instead of, or in conjunction with these controls, the media editing application of some embodiments provides other controls such as two separate controls for controlling the gain and the volume, two separate faders or knobs for individually controlling the audio levels of left and right channels, a record button for recording the audio, etc.

One or ordinary skill will also recognize that different display areas shown in the GUI **2200** is one of many possible configurations for the GUI of some embodiments. For instance, in some embodiments, the presence or absence of many of the display areas can be toggled through the GUI (e.g., the inspector display area **2225**, clip library **2205**, etc.). In addition, some embodiments allow the user to modify the size of the various display areas within the GUI. For instance, when the mixer **2255** is removed, the composite display area **2215** can increase in size to include that area. Similarly, the preview display area **2220** increases in size when the inspector display area **2225** is removed.

B. Example Software Architecture

In some embodiments, the processes described above are implemented as software running on a particular machine, such as a computer or a handheld device, or stored in a machine readable medium. FIG. **23** conceptually illustrates the software architecture of a media editing application **2300** of some embodiments. In some embodiments, the media editing application is a stand-alone application or is integrated into another application, while in other embodiments the application is implemented within an operating system. Furthermore, in some embodiments, the application is provided as part of a server-based solution. In some such embodiments, the application is provided via a thin client. That is, the application runs on a server while a user interacts with the application via a separate machine remote from the server. In other such embodiments, the application is provided via a thick client. That is, the application is distributed from the server to the client machine and runs on the client machine.

The media editing application **2300** includes a user interface (UI) interaction and generation module **2305**, a media ingest module **2310**, editing modules **2315**, effects modules **2340**, output components **2308**, a playback module **2325**, a metadata association module **2335**, and an effects association module **2330**.

The figure also illustrates stored data associated with the media editing application: source files **2350**, event data **2355**, project data **2360**, and other data **2365**. In some embodiments, the source files **2350** store media files (e.g., video files, audio files, combined video and audio files, etc.) imported into the application. The source files **2350** of some embodiments also store transcoded versions of the imported files as well as analysis data (e.g., people detection data, shake detection data, color balance data, etc.). The event data **2355** stores the events information used by some embodiments to populate the thumbnails view (e.g., in a clip browser). The event data **2355** may be a set of clip object data structures stored as one or more SQLite database (or other format) files in some embodiments. The project data **2360** stores the project information used by some embodiments to specify a composite presentation in the composite display area **2345**. The project data **2360** may also be a set of clip object data structures stored as one or more SQLite database (or other format) files in some embodiments.

In some embodiments, the four sets of data **2350**-**2365** are stored in a single physical storage (e.g., an internal hard drive, external hard drive, etc.). In some embodiments, the data may be split between multiple physical storages. For instance, the source files might be stored on an external hard drive with the event data, project data, and other data on an internal drive. Some embodiments store event data with their associated source files and render files in one set of folders, and the project data with associated render files in a separate set of folders.

FIG. **23** also illustrates an operating system **2370** that includes input device driver(s) **2375**, display module **2380**, and media import module **2385**. In some embodiments, as illustrated, the input device drivers **2375**, display module **2380**, and media import module **2385** are part of the operating system **2370** even when the media editing application **2300** is an application separate from the operating system **2370**.

The input device drivers **2375** may include drivers for translating signals from a keyboard, mouse, touchpad, tablet, touchscreen, etc. A user interacts with one or more of these input devices, each of which send signals to its corresponding device driver. The device driver then translates the signals into user input data that is provided to the UI interaction and generation module **2305**.

The present application describes a graphical user interface that provides users with numerous ways to perform different sets of operations and functionalities. In some embodiments, these operations and functionalities are performed based on different commands that are received from users through different input devices (e.g., keyboard, trackpad, touchpad, mouse, etc.). For example, the present application illustrates the use of a cursor in the graphical user interface to control (e.g., select, move) objects in the graphical user interface.

However, in some embodiments, objects in the graphical user interface can also be controlled or manipulated through other controls, such as touch control. In some embodiments, touch control is implemented through an input device that can detect the presence and location of touch on a display of the input device. An example of a device such functionality is a touch screen device (e.g., as incorporated into a smart phone, a tablet computer, etc.). In some embodiments, with touch control, a user directly manipulates objects by interacting with the graphical user interface that is displayed on the display of the touch screen device. For instance, a user can select a particular object in the graphical user interface by simply touching that particular object on the display of the touch screen device. As such, when touch control is utilized, a cursor may not even be provided for enabling selection of an object of a graphical user interface in some embodiments. However, when a cursor is provided in a graphical user interface, touch control can be used to control the cursor in some embodiments.

The display module **2380** translates the output of a user interface for a display device. That is, the display module **2380** receives signals (e.g., from the UI interaction and generation module **2305**) describing what should be displayed and translates these signals into pixel information that is sent to the display device. The display device may be an LCD, plasma screen, CRT monitor, touchscreen, etc.

The media import module **2385** receives media files (e.g., audio files, video files, etc.) from storage devices (e.g., external drives, recording devices, etc.) through one or more ports (e.g., a USB port, Firewire port, etc.) of the device on which the application **2300** operates and translates this media data for the media editing application or stores the data directly onto a storage of the device.

The UI interaction and generation module **2305** of the media editing application **2300** interprets the user input data received from the input device drivers **2375** and passes it to various modules, including the editing modules **2315**, the rendering engine **2320**, the playback module **2325**, the metadata association modules **2335**, and the effects association module **2330**. The UI interaction and generation module **2305** also manages the display of the UI, and outputs this display information to the display module **2380**. This UI display information may be based on information from the editing modules **2315**, the playback module **2325**, and the data **2350**-**2365**. In some embodiments, the UI interaction and generation module **2305** generates a basic GUI and populates the GUI with information from the other modules and stored data.

As shown, the UI interaction and generation module **2305** of some embodiments provides a number of different UI elements. In some embodiments, these elements include a tag display area **2306**, a composite display area **2345**, an effects association tool **2304**, an audio mixing tool **2318**, and a preview display area **2312**. All of these UI elements are described in detail above by reference to FIG. **22**.

The media ingest module **2310** manages the import of source media into the media editing application **2300**. Some embodiments, as shown, receive source media from the media import module **2385** of the operating system **2370**. The media ingest module **2310** receives instructions through the UI interaction and generation module **2305** as to which files should be imported, then instructs the media import module **2385** to enable this import (e.g., from an external drive, from a camera, etc.). The media ingest module **2310** stores these source files **2350** in specific file folders associated with the application. In some embodiments, the media ingest module **2310** also manages the creation of event data structures upon import of source files and the creation of the clip and asset data structures contained in the events. In some embodiments, the media ingest module **2310** tags the imported media clip with one or more metadata tags. For example, when a media clip is imported from a music library, the media ingest module **2310** might tag the clip with a "Music" tag. Alternatively, when the media clip is imported from a folder named "Dialog", the media ingest module **2310** might tag the clip with a "Dialog" tag.

The editing modules **2315** include a variety of modules for editing media in the clip browser as well as in the composite display area. The editing modules **2315** handle the creation of projects, addition and subtraction of clips from projects, trimming or other editing processes within the composite display area, or other editing processes. In some embodiments, the editing modules **2315** create and modify project and clip data structures in both the event data **2355** and the project data **2360**.

The effects association module **2330** of some embodiments associates an effect with a metadata tag. In some embodiments, the effect association module **2330** defines an effect chain with one or more effects for the metadata tag. The effect modules **2340** represent the various different effects, filters, transitions, etc. As mentioned above, there are many different effects or filters that can be associated with metadata to facilitate editing operations. Although this list is non-exhaustive, several example audio effects include different equalizers for modifying the signal strength of a clip within specified frequency ranges, a compressor/limiter for reducing the clip's dynamic range by attenuating parts of the audio signal above a particular threshold, an echo effect for creating an echo sound, and a reverb effect for creating a reverberation effect that emulates a particular acoustic environment. Several example video effects or image effects include color filters that operate on color values, different filters that sharpen, stylize, distort, or blur an image, and fade-in/fade-out effects for creating transitions between scenes. Several of these effect modules are associated with one or more settings or properties that the application's user can specify to edit media content.

In some embodiments, the output components **2308** generate the resulting output composite presentation based on one or more clips in the composite display area **2345**. As shown, the output components **2308** include a rendering engine **2320** and a mixer **2314**. However, depending on the type of output, the media editing application of some embodiments includes other component (e.g., encoders, decoders, etc). The rendering engine **2320** handles the rendering of images for the media editing application. In some embodiments, the rendering engine **2320** manages the creation of images for the media editing application. When an image is requested by a destination within the application (e.g., the playback module **2325**) the rendering engine **2320** outputs the requested image according to the project or event data. The rendering engine **2320** retrieves the project data or event data that identifies how to create the requested image and generates a render graph that is a series of nodes indicating either images to retrieve from the source files or operations to perform on the source files. In some embodiments, the rendering engine **2320** schedules the retrieval of the necessary images through disk read operations and the decoding of those images.

In some embodiments, the rendering engine **2320** performs various operations to generate an output image. In some embodiments, these operations include blend operations, effects (e.g., blur or other pixel value modification operations), color space conversions, resolution transforms, etc. In some embodiments, one or more of these processing operations are actually part of the operating system and are performed by a GPU or CPU of the device on which the application **2300** operates. The output of the rendering engine (a rendered image) may be stored as render files in storage **2365** or sent to a destination for additional processing or output (e.g., playback).

In some embodiments, the mixer **2314** receives several audio signals of different clips and outputs a mixed audio signal. The mixer **2314** of some embodiments is utilized in number of different instances during the non-linear editing process. For example, the mixer may be utilized in generating a composite presentation from multiple different clips. The mixer can also act as the master to output a mixed audio signal, as described in many of the examples above. In some embodiments, the media editing application includes different types of mixers for mixing audio. For example, the media editing application can include a first mixer for mixing one type of audio file and a second mixer for mixing another type of audio file.

The playback module **2325** handles the playback of images (e.g., in a preview display area **2312** of the user interface). Some embodiments do not include a playback module and the rendering engine directly outputs its images for integration into the GUI, or directly to the display module **2380** for display at a particular portion of the display device.

In some embodiments, the metadata association module **2335** associates clips with metadata tags. Different embodiments provide different ways of associating media clips with metadata tags. In some embodiments, the metadata tags indicate pre-defined categories (e.g., dialog, music) that an editor can select to categorize different clips. Instead of, or in conjunction with, these categories, some embodiments allow the editor to specify one or more keywords to associate with the media clips. For instance, in some such embodiments, the media editing application provides a keyword association tool that displays different keywords for tagging the media content. To tag a clip, the application's user drags and drops the clip onto a particular keyword in the keyword association tool. The same technique is used in some embodiments to associate multiple clips by simultaneously dragging and dropping the clips onto the particular keyword.

In addition, some embodiments automatically associate one or more metadata tags with a media clip. In some such embodiments, this automatic association is based on a number of different factors including the source of the media clip (e.g., based on the library or camera from which the clip was imported), based on an analysis of the media clip (e.g., based on color balance analysis, image stabilization analysis, audio channel analysis, etc.). For example, the media editing application might tag one set of clips from a music library as "Music" and tag another set of clips from a sound effects library as "SFX". Alternatively, the automatic association can be based on an analysis of the media content (e.g., based on color balance analysis, image stabilization analysis, audio channel analysis, people analysis, etc.). As mentioned above, in some embodiments, the media ingest module **2310** can also perform at least some of the metadata association task when importing media content into the media editing application **2300**. In some embodiments, the media editing application includes one or more analysis modules for analyzing the number of people (e.g., one person, two persons, group, etc.) in a clip and/or a type of shot (e.g., a close-up, medium, or wide shot). Other types of analysis modules can include image stabilization analysis modules (e.g., for camera movements), color balance analysis modules, audio analysis modules (e.g., for mono, stereo, silent channels), metadata analysis, etc. In some embodiments, metadata tags represent metadata that are embedded in media content. For example, some video cameras embed frame rate, creation date, and encoding info into video clips that they capture. In addition some devices embed other metadata such as location data, audio channel count, sample rate, file type, camera type, exposure info, etc.

While many of the features of the media editing application **2300** have been described as being performed by one module (e.g., the UI interaction and generation module **2305**, the media ingest module **2310**, etc.), one of ordinary skill in the art will recognize that the functions described herein might be split up into multiple modules. Similarly, functions described as being performed by multiple different modules might be performed by a single module in some embodiments (e.g., the playback module **2325** might be part of the UI interaction and generation module **2305**).

C. Example Data Structure

FIG. **24** conceptually illustrates example data structures for several objects associated with the media editing application of some embodiments. Specifically, this figure illustrates a sequence **2435** that references a primary collection data structure **2440**. Here, the primary collection data structure **2440** is in itself a group of one or more clip objects or collection objects. As shown, the figure illustrates (1) a clip object **2405**, (2) a component object **2410**, (3) a tag object **2420**, (4) an effect object **2430**, (5) the sequence object **2435**, (6) the primary collection object **2440**, and (7) an asset object **2445**.

As shown in FIG. **24**, the sequence **2435** includes a sequence ID and sequence attributes. The sequence ID identifies the sequence **2435**. In some embodiments, the application's user sets the sequence attributes for the project represented in the composite display area. For example, the user might have specified several settings that correspond to these sequence attributes when creating the project. The sequence **2435** also includes a pointer to a primary collection **2440**.

The primary collection **2440** includes the collection ID and the array of clips. The collection ID identifies the primary collection. The array references several clips (i.e., clip **1** to clip N). These represent clips or collections that have been added to the composite display area. In some embodiments, the array is ordered based on the locations of media clips in the composite display area and only references clips in the primary lane of the primary collection. An example of one or more clips in the primary lane of the composite display area is described above by reference to FIG. **22**.

The clip object **2405** or collection object, in some embodiments, is an ordered array of clip objects. The clip object **2405** references one or more component clips (e.g., the component object **2410**) in the array. In addition, the clip object **2405** stores a clip ID that is a unique identifier for the clip object. In some embodiments, the clip object **2405** is a collection object that can reference component clip objects as well as additional collection objects. An example of such collection object is a compound clip that references multiple different clips. In some embodiments, the clip object **2405** or collection object only references the video component clip in the array, and any additional components (generally one or more audio components) are then anchored to that video component.

As shown in FIG. **24**, the clip object **2405** is associated with one more metadata tags (i.e., tags **1**-N). In some embodiments, these tags represent those that are associated by the application's user. Alternatively, one or more of these tags can be tags specified by the media editing application. For example, when a media clip is imported from a music library, the media editing application might tag the clip with a

"Music" tag. Alternatively, when the media clip is imported from a folder named "Dialog", the media editing application might tag the clip with a "Dialog" tag.

The component object **2410** includes a component ID, an asset reference, and anchored components. The component ID identifies the component. The asset reference of some embodiments uniquely identifies a particular asset object. In some embodiments, the asset reference is not a direct reference to the asset but rather is used to locate the asset when needed. For example, when the media editing application needs to identify a particular asset, the application uses an event ID to locate an event object (not shown) that contains the asset, and then the asset ID to locate the particular desired asset. Several examples of clips associated with an event or an event folder are described above by reference to FIG. **22**.

In some embodiments, the clip object **2405** only stores the video component clip in its array, and any additional components (generally one or more audio components) are then anchored to that video component. This is illustrated in FIG. **24** as the component object **2410** includes a set of one or more anchored components **2415** (e.g., audio components). In some embodiments, each component that is anchored to another clip or collection stores an anchor offset that indicates a particular instance in time along the range of the other clip or collection. That is, the anchor offset may indicate that the component is anchored x number of seconds and/or frames into the other clip or collection. In some embodiments, the offset refers to the trimmed ranges of the clips.

As shown, the asset object **2445** includes an asset ID, reference to a source file, and a set of source file metadata. The asset ID identifies the asset, while the source file reference is a pointer to the original media file. The set of source file metadata is different for different media clips. Examples of source file metadata include the file type (e.g., audio, video, movie, still image, etc.), the file format (e.g., ".mov", ".avi", etc), different video properties, audio properties, etc.

In the example illustrated in FIG. **24**, the tag object **2420** includes a tag ID that identifies the tag, a tag name that represents the metadata tag, and an effect list **2425** that represents the one or more effects associated with the metadata tag. In some embodiments, the tag object **2425** includes an output track that represents the output track associated with the metadata tag. Several examples of such output track are described above by reference to FIGS. **18-20**.

As shown in FIG. **24**, the effects object **2430** includes an effect ID and effect properties. The effect ID identifies the effect. In some embodiments, the effect properties are based on parameters specified using an effect properties tool. The properties tool can include different user interface items to specify different parameters or settings for the effect.

One of ordinary skill will also recognize that the data structures shown in FIG. **24** are just a few of the many different possible configurations for implementing the editing features described above. For instance, in some embodiments, instead of multiple tags per clip, only one tag (e.g., role, category) is assigned to the clip. For example, several clips may be assigned one audio role of "Dialog", "Music", or "SFX". When multiple tags per clip are supported, the media editing application applies different sets of effects in parallel. For example, if a clip is tagged with both first and second tags, the media editing application applies a first set of effects associated with the first tag, and applies a second set of effects in parallel with the first set of effect. Also, in the example illustrated in FIG. **24**, the tag object **2420** can be associated with the component object **2410** or the asset object **2445** instead of the clip object **2405**.

VII. Electronic System

Many of the above-described features and applications are implemented as software processes that are specified as a set of instructions recorded on a computer readable storage medium (also referred to as computer readable medium). When these instructions are executed by one or more processing unit(s) (e.g., one or more processors, cores of processors, or other processing units), they cause the processing unit(s) to perform the actions indicated in the instructions. Examples of computer readable media include, but are not limited to, CD-ROMs, flash drives, random access memory (RAM) chips, hard drives, erasable programmable read only memories (EPROMs), electrically erasable programmable read-only memories (EEPROMs), etc. The computer readable media does not include carrier waves and electronic signals passing wirelessly or over wired connections.

In this specification, the term "software" is meant to include firmware residing in read-only memory or applications stored in magnetic storage, which can be read into memory for processing by a processor. Also, in some embodiments, multiple software inventions can be implemented as sub-parts of a larger program while remaining distinct software inventions. In some embodiments, multiple software inventions can also be implemented as separate programs. Finally, any combination of separate programs that together implement a software invention described here is within the scope of the invention. In some embodiments, the software programs, when installed to operate on one or more electronic systems, define one or more specific machine implementations that execute and perform the operations of the software programs.

FIG. **25** conceptually illustrates an electronic system **2500** with which some embodiments of the invention are implemented. The electronic system **2500** may be a computer (e.g., a desktop computer, personal computer, tablet computer, etc.), phone (e.g., smart phone), PDA, or any other sort of electronic device. Such an electronic system includes various types of computer readable media and interfaces for various other types of computer readable media. Electronic system **2500** includes a bus **2505**, processing unit(s) **2510**, a graphics processing unit (GPU) **2515**, a system memory **2520**, a network **2525**, a read-only memory **2530**, a permanent storage device **2535**, input devices **2540**, and output devices **2545**.

The bus **2505** collectively represents all system, peripheral, and chipset buses that communicatively connect the numerous internal devices of the electronic system **2500**. For instance, the bus **2505** communicatively connects the processing unit(s) **2510** with the read-only memory **2530**, the GPU **2515**, the system memory **2520**, and the permanent storage device **2535**.

From these various memory units, the processing unit(s) **2510** retrieves instructions to execute and data to process in order to execute the processes of the invention. The processing unit(s) may be a single processor or a multi-core processor in different embodiments. Some instructions are passed to and executed by the GPU **2515**. The GPU **2515** can offload various computations or complement the image processing provided by the processing unit(s) **2510**.

The read-only-memory (ROM) **2530** stores static data and instructions that are needed by the processing unit(s) **2510** and other modules of the electronic system. The permanent storage device **2535**, on the other hand, is a read-and-write memory device. This device is a non-volatile memory unit that stores instructions and data even when the electronic system **2500** is off. Some embodiments of the invention use a mass-storage device (such as a magnetic or optical disk and its corresponding disk drive) as the permanent storage device **2535**.

Other embodiments use a removable storage device (such as a floppy disk, flash memory device, its corresponding disk drive, etc.) as the permanent storage device. Like the permanent storage device **2535**, the system memory **2520** is a read-and-write memory device. However, unlike storage device **2535**, the system memory **2520** is a volatile read-and-write memory, such as a random access memory. The system memory **2520** stores some of the instructions and data that the processor needs at runtime. In some embodiments, the invention's processes are stored in the system memory **2520**, the permanent storage device **2535**, and/or the read-only memory **2530**. For example, the various memory units include instructions for processing multimedia clips in accordance with some embodiments. From these various memory units, the processing unit(s) **2510** retrieves instructions to execute and data to process in order to execute the processes of some embodiments.

The bus **2505** also connects to the input and output devices **2540** and **2545**. The input devices **2540** enable the user to communicate information and select commands to the electronic system. The input devices **2540** include alphanumeric keyboards and pointing devices (also called "cursor control devices"), cameras (e.g., webcams), microphones or similar devices for receiving voice commands, etc. The output devices **2545** display images generated by the electronic system or otherwise output data. The output devices **2545** include printers and display devices, such as cathode ray tubes (CRT) or liquid crystal displays (LCD), as well as speakers or similar audio output devices. Some embodiments include devices such as a touchscreen that function as both input and output devices.

Finally, as shown in FIG. **25**, bus **2505** also couples electronic system **2500** to a network **2525** through a network adapter (not shown). In this manner, the computer can be a part of a network of computers (such as a local area network ("LAN"), a wide area network ("WAN"), or an Intranet, or a network of networks, such as the Internet. Any or all components of electronic system **2500** may be used in conjunction with the invention.

Some embodiments include electronic components, such as microprocessors, storage and memory that store computer program instructions in a machine-readable or computer-readable medium (alternatively referred to as computer-readable storage media, machine-readable media, or machine-readable storage media). Some examples of such computer-readable media include RAM, ROM, read-only compact discs (CD-ROM), recordable compact discs (CD-R), rewritable compact discs (CD-RW), read-only digital versatile discs (e.g., DVD-ROM, dual-layer DVD-ROM), a variety of recordable/rewritable DVDs (e.g., DVD-RAM, DVD-RW, DVD+RW, etc.), flash memory (e.g., SD cards, mini-SD cards, micro-SD cards, etc.), magnetic and/or solid state hard drives, read-only and recordable Blu-Ray® discs, ultra density optical discs, any other optical or magnetic media, and floppy disks. The computer-readable media may store a computer program that is executable by at least one processing unit and includes sets of instructions for performing various operations. Examples of computer programs or computer code include machine code, such as is produced by a compiler, and files including higher-level code that are executed by a computer, an electronic component, or a microprocessor using an interpreter.

While the above discussion primarily refers to microprocessor or multi-core processors that execute software, some embodiments are performed by one or more integrated circuits, such as application specific integrated circuits (ASICs) or field programmable gate arrays (FPGAs). In some embodiments, such integrated circuits execute instructions that are stored on the circuit itself.

As used in this specification and any claims of this application, the terms "computer", "server", "processor", and "memory" all refer to electronic or other technological devices. These terms exclude people or groups of people. For the purposes of the specification, the terms display or displaying means displaying on an electronic device. As used in this specification and any claims of this application, the terms "computer readable medium," "computer readable media," and "machine readable medium" are entirely restricted to tangible, physical objects that store information in a form that is readable by a computer. These terms exclude any wireless signals, wired download signals, and any other ephemeral signals.

While the invention has been described with reference to numerous specific details, one of ordinary skill in the art will recognize that the invention can be embodied in other specific forms without departing from the spirit of the invention. In addition, a number of the figures (including FIGS. **1**, **10**, **15**, **16**, and **21**) conceptually illustrate processes. The specific operations of these processes may not be performed in the exact order shown and described. The specific operations may not be performed in one continuous series of operations, and different specific operations may be performed in different embodiments. Furthermore, the process could be implemented using several sub-processes, or as part of a larger macro process. In addition, some embodiments execute software stored in programmable logic devices (PLDs), ROM, or RAM devices.

In addition, many of the user interface controls described above relates to controlling audio. However, one of ordinary skill in the art would recognize that similar controls can be provided for image effect or filters. For example, one or more user interface controls (e.g., sliders, knobs, buttons) can be provided for each metadata tag to control the effect settings (e.g., brightness, sharpness, amount of distortion, fade-in effect, fade-out effect, etc.).

In many of the examples described herein, a media editing application uses metadata to facilitate editing operations. However, one of ordinary skill in the art would recognize that the metadata features can be provided for different types of applications or programs (e.g., an image organizing application, a server-side web application, an operating system framework). For instance, the metadata features can be provided in an image application that allows the application's user to associate different items with keywords, and apply one or more effects to those items based on the association of the keywords, and/or output those items to different tracks (e.g., files, channels) based on the association of the keywords. Thus, one of ordinary skill in the art would understand that the invention is not to be limited by the foregoing illustrative details, but rather is to be defined by the appended claims.

What is claimed is:

1. A non-transitory machine readable medium storing a program for applying effects to a composite presentation comprising a plurality of media clips, the program for execution by at least one processing unit, the program comprising sets of instructions for:

- associating a set of effects with each tag of a plurality of tags, wherein at least two tags of the plurality of tags are associated with different sets of effects;
- assigning the plurality of tags to media clips of the plurality of media clips; and

in response to a request to output the composite presentation, for each particular tag of the plurality of tags:

identifying a set of media clips of the plurality of media clips to which the particular tag is assigned;

identifying the set of effects associated with the particular tag; and

applying the identified set of effects associated with the particular tag to each media clip in the identified set of media clips in order to output the composite presentation, such that a same set of effects is applied to any two media clips that are assigned the same particular tag.

2. The non-transitory machine readable medium of claim **1**, wherein the set of instructions for associating a set of effects with each tag comprises a set of instructions for associating an effect chain with at least one tag, the effect chain comprising a series of effects that is applied in sequence to each media clip that is tagged with the associated tag.

3. The non-transitory machine readable medium of claim **1**, wherein for at least one tag of the plurality of tags, the identified set of media clips comprises audio data, wherein the set of instructions for applying the identified set of effects to each media clip in the identified set of media clips comprises sets of instructions for:

routing a composite audio signal of one or more media clips in the identified set of media clips over an auxiliary bus using a send operation;

applying one or more effects to the composite audio signal; and

returning a processed audio signal with the one or more effects.

4. The non-transitory machine readable medium of claim **3**, wherein the set of instructions for applying the identified set of effects to each media clip in the identified set of media clips further comprises a set of instructions for combining the processed audio signal with the audio signal of the one or more media clips in the identified set of media clips.

5. The non-transitory machine readable medium of claim **3**, wherein the identified set of effects for a first tag comprises a first type of effect and the identified set of effects for a second tag comprises a second type of effect, wherein the set of instructions for applying the identified set of effects to each media clip in the identified set of media clips further comprises a set of instructions for applying the first type of effect using the send operation and applying the second type of effect as an insert effect, wherein the insert effect is applied to an audio signal of an individual media clip instead of a composite audio signal of multiple media clips.

6. The non-transitory machine readable medium of claim **1**, wherein for at least one tag of the plurality of tags, the identified set of media clips comprises audio data, wherein the set of instructions for applying the identified set of effects to each media clip in the identified set of media clips comprises a set of instructions for applying the identified set of effects as a set of insert effects, wherein each insert effect is applied to an audio signal of the media clip instead of a composite audio signal of multiple clips in the identified set of media clips.

7. The non-transitory machine readable medium of claim **1**, wherein the program further comprises a set of instructions for specifying properties or settings for one or more effects of the sets of effects.

8. The non-transitory machine readable medium of claim **1**, wherein one or more effects of the sets of effects are audio effects comprising at least one of a reverb effect, an echo effect, an equalizer, and a compressor.

9. The non-transitory machine readable medium of claim **1**, wherein one or more effects of the sets of effects are video effects comprising at least one of a color filter, a sharpen filter, a distort filter, a blur filter, and a video transition.

10. The non-transitory machine readable medium of claim **1**, wherein for at least one tag of the plurality of tags, the identified set of media clips comprises at least one compound clip that contains multiple different inner clips.

11. The non-transitory machine readable medium of claim **1**, wherein the set of instructions for assigning the plurality of tags to media clips comprises sets of instructions for:

displaying a list of keywords for the media clips;

receiving user input to identify a set of the keywords for the media clips; and

assigning a set of tags associated with the identified set of keywords to the media clips.

12. The non-transitory machine readable medium of claim **1**, wherein the set of instructions for assigning the plurality of tags to media clips comprises sets of instructions for automatically assigning a set of tags to a particular media clip based on properties of the particular media clip.

13. A non-transitory machine readable medium storing a program for applying effects to a composite presentation comprising a plurality of media clips, the program for execution by at least one processing unit, the program comprising sets of instructions for:

associating a plurality of first effects with a first tag and a different plurality of second effects with a second tag;

assigning the first tag to each media clip in a first set of media clips of the composite presentation, the first set of media clips comprising at least one compound clip that contains multiple different inner clips;

assigning the second tag to each media clip in a second set of media clips of the composite presentation, where the first and second tags associate each media clip of the first and second sets, respectively, with the first and second effects;

in response to a request to generate an output of the composite presentation, identifying a set of effects, including the first and second effects, to apply to the media clips of the composite presentation based on different tags associated with the media clips; and

based on the identification, applying the plurality of first effects to the first set of media clips and the plurality of second effects to the second set of media clips in order to output the composite presentation based on the association of the pluralities of effects with the different tags, wherein applying the plurality of first effects to the first set of media clips comprises identifying each tag of the compound clip and the compound clip's inner clips, and determining, based on the identification, whether to apply a particular plurality of effects to the compound clip or one or more of the compound clip's inner clips.

14. A method for applying effects to a composite presentation comprising a plurality of media clips, the method comprising:

associating a set of effects with each tag of a plurality of tags, wherein at least two tags of the plurality of tags are associated with different sets of effects;

assigning the plurality of tags to media clips of the plurality of media clips; and

in response to a request to output the composite presentation, for each particular media clip of the plurality of media clips:

identifying a set of tags of the plurality of tags assigned to the particular media clip;

identifying the sets of effects associated with the identified set of tags; and

applying the identified sets of effects to the particular media clip in order to output the composite presentation such that a same set of effects is applied to any two media clips that are assigned the same particular tag.

15. The method of claim **14**, wherein associating a set of effects with each tag comprises associating an effect chain with at least one tag, the effect chain comprising a series of effects that is applied in sequence to each media clip that is tagged with the associated tag.

16. The method of claim **14**, wherein a set of media clips of the plurality of media clips comprises audio data, wherein applying the identified sets of effects to media clips of the set of media clips comprises routing a composite audio signal of one or more media clips in the set of media clips over an auxiliary bus using a send operation, applying one or more effects to the composite audio signal, and returning a processed audio signal with the one or more effects.

17. The method of claim **16**, wherein applying the identified sets of effects to media clips of the set of media clips further comprises combining the processed audio signal with the audio signal of the one or more media clips in the set of media clips.

18. The method of claim **14**, wherein the identified set of effects for a first tag comprises a first type of effect and the identified set of effects for a second tag comprises a second type of effect, wherein applying the identified sets of effects to the particular media clip comprises applying the first type of effect using a send operation and applying the second type of effect as an insert effect, wherein the insert effect is applied to an audio signal of an individual media clip instead of a composite audio signal of multiple media clips.

19. The method of claim **14**, wherein a set of media clips of the plurality of media clips comprises audio data, wherein applying the identified sets of effects to the media clips of the set of media clips comprises applying at least one effect of the sets of effects as a set of insert effects, wherein each insert effect is applied to an audio signal of the media clip instead of a composite audio signal of multiple clips in the set of media clips.

20. The method of claim **14** further comprising specifying properties or settings for one or more effects of the sets of effects.

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